Teledermatology: Economics and Cost-Effectiveness

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Introduction

Dermatology is a natural fit for telemedicine applications given its visual nature. However, despite several decades of use across countries and healthcare systems, there remains a lack of consensus regarding the economic effects of teledermatology. In this chapter, we will outline the current landscape of knowledge regarding teledermatology's cost and cost-effectiveness.

Healthcare Cost-Effectiveness Definitions

Overall, most studies examining cost-effectiveness use methods comparing two or more healthcare options and determine which provides the most benefit for the least relative cost. A major barrier to generalizability of any cost-effectiveness study is the wide variability in structures and payment models for teledermatology, as each analysis will be limited to an individual system's unique characteristics. Additionally, assessing cost-effectiveness requires defining who is burdening the cost and who is receiving the benefit.

In order to discuss the cost-effectiveness of teledermatology, we will first review and define some general terms and cost components used to measure cost-effectiveness within healthcare, while also examining differing beneficiary perspectives.

Payor Structure

Insurance

Payment for most healthcare delivered in the United States is mediated through health insurance, and cost analyses may take the perspective of cost to the insurer or cost to the insured. In the United States, the fee-for-service insurance model is the most common [1], whereby the insurer pays the provider or health system for each service rendered. In other insurance models, such as capitated systems and value-based care systems, the system may receive a flat payment for each patient enrolled. Regarding costs to the insured under a health insurance model, the insured pay premiums, often subsidized by their employer or federal and/or state governments. When individuals access medical care, payments are mediated through the insurer and the amount paid by the individual depends upon the structure

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of the health insurance plan [2]. Many insurance plans have deductibles or require the insured to pay a percentage of medical costs. Cost to the insured for any service, including telemedicine, varies widely depending on the plan structure and the contract negotiated by each insurer with the provider or healthcare system.

Service Contract

A service contract describes a payment arrangement where the dermatology provider has a contract to bill the healthcare system on a per-case basis independent of medical insurance. An example of this would be a primary care clinic paying a dermatologist a fixed amount per teledermatology case reviewed [2].

Out-of-Pocket

With out-of-pocket payments, patients or their employers pay directly for the services they receive without mediation through insurance reimbursements. Some examples of out-of-pocket healthcare spending include concierge medicine, direct private care, and certain medical services not covered by insurance, such as elective cosmetic procedures. In recent years, online direct-to-consumer healthcare delivery platforms have emerged, including primary care, mental healthcare, pharmaceutical services, and other forms of in-person care or telehealth where patients pay the provider directly without an insurance intermediary. Teledermatology is no exception, with many private direct-to-consumer companies adopting a direct payment model [2].

Beneficiary Perspective

Healthcare System Cost-Effectiveness

The typical beneficiary perspective pursued for cost-effectiveness analyses among healthcare interventions is that of the healthcare system. From this perspective, the objective is to select the strategy of healthcare delivery that produces the least cost for the healthcare system without negatively impacting the quality of healthcare delivered [3]. Effective strategies from this perspective lead to increased efficiency of healthcare delivery. Increased efficiency can come in the form of either increased quality of healthcare delivery or decreased costs [4]. Ways to increase the quality of healthcare delivery include implementing interventions that lead to more accurate diagnosis and management of medical problems and facilitate improved adherence among patients. Strategies that decrease costs include those that decrease overhead costs associated with healthcare delivery (e.g., clinic space, equipment, personnel) or decrease the total amount of healthcare that needs to be delivered.

Patient/Societal Cost-Effectiveness

An increasingly popular perspective among cost-effectiveness analyses is from that of society or the individual patient. From this perspective, delivering higher quality, more efficient care at a lower cost is still favored. However, rather than solely focusing on the health benefits obtained at a set cost to the healthcare system, this perspective also incorporates other societal or individual costs tangential to healthcare [3]. For example, these types of cost-effectiveness analyses also incorporate costs associated with attending medical appointments, including the costs of missing work, arranging childcare, and traveling to the medical office. Pursuing cost-effectiveness analyses from the perspective of society at large is increasingly favored as a more holistic approach to evaluating healthcare interventions and strategies [4].

Cost Implications of the Two Major Models of Teledermatology: Store-and-Forward vs. Live Interactive

Teledermatology systems and payment models can be organized into many different structures, each with unique effects on economics. We will outline some factors contributing to costs and savings, highlighting the two primary telederma-

tology models that have been economically evaluated in the published literature.

Store-and-Forward Teledermatology

In store-and-forward teledermatology (SAFT), photos of a dermatologic problem are sent to a dermatologist for asynchronous review. There are multiple models of SAFT. SAFT may be initiated by a patient who desires a consultation from a dermatology provider, or from a non-dermatology provider who seeks advice on virtual comanagement or triaging of dermatologic problems for their patients [5].

Direct-to-Consumer

In this form of SAFT, patients can upload photos to a for-profit web platform or application staffed by providers who are independent contractors and generally not part of the patient's healthcare network or system. Many of these platforms limit the diagnoses they provide consultation for, and most only accept direct payment, although a handful accepts insurance [6, 7]. Some studies have questioned the quality of care provided through these platforms [8, 9].

Patient-to-Provider

During the COVID-19 pandemic, regulatory burdens on telemedicine (HIPAA waivers, telemedicine practice across state lines) were relaxed and many insurances began offering fee-for-service reimbursement for SAFT [10]. As such, patients and providers are increasingly taking advantage of the option to allow patients to upload photos to their electronic health record platform and request a virtual consultation from their existing dermatology provider. Under some circumstances, the provider may bill the insurer for this service. One recent study found that patient-submitted photographs are not consistently of sufficient quality to facilitate teledermatology review [11]. Furthermore, the economic implications of this model have not yet been evaluated as of this publication.

Provider-to-Provider

Healthcare systems with capitated payment models tasked with providing medical care to large patient cohorts for flat payments have economically benefited by using SAFT as a triaging mechanism [12, 13]. In this model, the dermatologist determines whether the patient needs to be seen in-person by a dermatologist or whether the primary care physician can manage the patient's dermatologic problem with treatment recommendations from the dermatology provider. There is no universal triaging framework for teledermatology, but the determination is typically made based on some combination of diagnosis, disease severity, patient distance from the nearest dermatology office, and need for a dermatology-based procedure, among other considerations.

Cost-Effectiveness of Store-and-Forward Teledermatology

Based on the current literature, it seems that provider-to-provider SAFT leads to cost savings compared to standard in-person referral systems in most cases, although it was cost neutral in a minority of cases (Table 6.1) [12–28]. Below, we describe the unique cost components and benefits of SAFT from a cost-effectiveness perspective.

Costs Associated with Store-and-Forward Teledermatology

Hardware and Software

Costs associated with hardware and software necessary to facilitate SAFT are unique additional costs that are less applicable to standard in-person visits [13, 14, 22, 23, 25, 27]. SAFT referral systems may be built into existing electronic medical records or require a separate soft-

Table 6.1 Cost-effectiveness analyses of store-and-forward teledermatology systems

Primary author [citation]	Year	Country	Patient/societal costs included	Cost implications
Datta [13]	2015	The United States	Yes	Cost-effective
Eminović [14]	2010	The Netherlands	Yes	Cost neutral
Ferrándiz [15]	2008	Spain	Yes	Cost-effective
Lim [16]	2012	New Zealand	No	Cost-effective
Livingstone [17]	2015	The United Kingdom	No	Cost-effective
Lopez-Villegas [18]	2020	Spain	Yes	Cost-effective
Moreno-Ramirez [19]	2009	Spain	Yes	Cost-effective
Morton [20]	2011	The United Kingdom	No	Cost-effective
Os-Medendorp [21]	2012	The Netherlands	Yes	Cost-effective
Pak [22]	2009	The United States	Yes	Cost-effective
Parsi [23]	2012	The United States	Yes	Cost-effective
van der Heijden [24]	2011	The Netherlands	No	Cost-effective
Vidal-Alaball [25]	2018	Spain	Yes	Cost-effective
Whited [26]	2003	The United States	Yes	Cost neutral
Yang [27]	2018	The United States	No	Cost-effective
Zakaria [12]	2021	The United States	No	Cost-effective
Zarca [28]	2018	France	No	Cost-effective

ware application. In addition to software costs, other technological costs associated with SAFT include devices (e.g., cameras, computers) and ongoing software and IT support. These costs are primarily front-loaded, meaning that the establishment of a SAFT system often requires an upfront financial commitment [12].

With the widespread adoption of electronic health record systems at most major institutions, some systems have built-in applications that allow providers to use their own devices or smartphones to securely upload photos directly into a patient's chart, and to link that photo to an electronic consultation [29]. Practitioners and healthcare systems encouraging this practice may lead to reductions in some of the aforementioned hardware and software costs.

Personnel, Training, and Overhead

Other costs associated with implementation of a SAFT system include training costs for both referring and reviewing providers, cost for clinic space to review the referrals, and compensation for reviewing dermatologists. Costs also depend on the context under which the referring and reviewing providers operate (i.e., from home versus from the medical office, using their own device/equipment versus those belonging to a medical practice). As with hardware and software, some of the costs associated with personnel and training will be front-loaded and therefore relative additional costs should decrease with increased patient volume over time [12].

Cost Savings Associated with Store-and-Forward Teledermatology

The cost savings associated with SAFT are derived primarily via the reduction in the number of live, in-person healthcare visits to facilitate decreased societal costs for patients and decreased healthcare costs for the medical system [12].

Patient/Societal Perspective

From the patient perspective, those who submit a teledermatology referral and can be managed without an in-person dermatology appointment avoid incurring the costs associated with attending in-person clinic visits, such as unpaid work leave, childcare, and transportation. Additionally, studies have found that SAFT has the potential to shorten wait times for accessing dermatologic care compared to traditional in-person referral options [29, 30]. Expedited care likely benefits patients, who experience a quicker time to diagnosis and appropriate management, and hypothetically leads to fewer outpatient, urgent and emergent medical vis-

its attributed to disease progression. Additionally, quicker time to diagnosis likely also reduces patient discomfort, frustration, and possibly missed work while patients are waiting to be evaluated by a dermatologist [18, 19, 23, 26]. However, more data are needed to confirm these hypotheses.

Healthcare System Perspective

The economic implications of SAFT from the medical system perspective depend upon the payment model being used. For closed or capitated medical systems, such as those that exist in the United Kingdom and Sweden [31, 32], certain US systems (e.g., Veterans Affairs system, some county hospitals), or integrated managed-care delivery systems (i.e., Kaiser Permanente), the healthcare system or provider is paid a fixed amount regardless of the amount of medical care delivered. Therefore, the incentive for these systems is to provide efficient care and limit the need for unnecessary visits [12, 13, 26, 27]. Closed systems also save on costs by steering patients towards comparatively less expensive primary care visits instead of dermatology visits. These incentives align well with the goals of SAFT, and therefore multiple healthcare systems have been shown to benefit from the cost savings associated with SAFT triage (Table 6.1). Conversely, in fee-for-service payment models, such as those that exist in most systems in the United States and Japan, the medical system is reimbursed for the number of services or procedures they provide [1, 2]. Therefore, the incentive for these systems is to provide a higher amount of healthcare, with a greater focus on generating revenue rather than limiting costs. From the perspective of the United States, SAFT services generally have poor reimbursement rates, and prior to the COVID-19 pandemic, were only approved for select circumstances, such as for rural patients who had established care with a dermatologist but lived far away from their office [10]. The COVID-19 pandemic has led to legislative changes that have improved reimbursement rates and eased restrictions in providing SAFT services, but SAFT still remains underutilized in fee-for-service healthcare systems given the hurdles to revenue generation [10]. Please see Chap. 9 on Regulations and Reimbursement for more information on this topic.

Live Interactive Teledermatology

In live interactive teledermatology, patients engage directly with a dermatologist via videoconferencing in real-time. Before the COVID-19 pandemic, this form of teledermatology was primarily used to provide care to patients living in rural or remote areas who would otherwise need to travel a great distance to be seen by a dermatologist. During the COVID-19 pandemic, it was widely adopted across many systems and specialties to limit in-person interactions [10]. While studies have been mixed regarding patient and provider preferences for live teledermatology compared to in-person visits [33–35], many institutions have continued to practice live teledermatology given its inherent convenience. In contrast to the triaging goal of SAFT, live interactive teledermatology functions similarly to an in-person clinic visit in which evaluation, diagnosis, and management plan are performed in real-time and transmitted immediately to the patient through direct provider-patient communication. Live interactive visits have primarily been described within traditional fee-for-service or capitated insurance models (Table 6.2). Direct-to-consumer models for live interactive teledermatology visits have not been documented in the current literature, though such arrangements probably exist in practice given the growing popularity of concierge or direct private healthcare models.

Cost-Effectiveness of Live Interactive Teledermatology

Studies regarding the cost-effectiveness of live teledermatology systems have yielded mixed results, with live interactive teledermatology producing cost savings in some systems and increased costs in others (Table 6.2) [36–44]. Importantly, the most recent study to evaluate cost-effectiveness of live interactive teledermatology is from 2007 as per our literature review

Table 6.2 Cost-Effectiveness analyses of live interactive teledermatology systems

Primary author [citation]	Year	Country	Patient/societal costs included	Cost implications
Armstrong [36]	2007	The United States	No	Cost-effective
Bergmo [37]	2000	Norway	Yes	Cost-effective
Burgiss [38]	1997	The United States	No	Cost-effective
Loane [39]	2001	New Zealand	Yes	Cost-effective
Loane [40]	2001	New Zealand	No	More costly
Oakley [41]	2000	The United Kingdom, New Zealand	Yes	Cost-effective
Persaud [42]	2005	Canada	Yes	More costly
Seghers [43]	2006	Singapore	Yes	Cost-effective
Wootton [44]	2000	The United Kingdom	Yes	More costly

[36]. Therefore, any analysis is based on literature from 15 to 25 years ago. Given the advent of modern web-based videoconferencing technology and the ability to use personal smartphones and other devices to access videoconferencing platforms, we can hypothesize that more current analyses might yield different results. Nonetheless, similar to SAFT, the overall cost-effectiveness of live interactive teledermatology depends upon the circumstances under which the teledermatology is being performed and the balance between associated costs and savings.

Increased Costs Associated with Live Interactive Teledermatology

Hardware and Software

Implementation of a live interactive teledermatology system is associated with several costs. First, live interactive teledermatology requires both the dermatologist and the patient to have the appropriate technological capabilities to participate in a videoconferencing call [40, 43]. These include video cameras, audio set-ups (e.g., microphone, headset), and videoconferencing software that is compliant with patient privacy laws. In addition, ongoing software and IT support are often required. As with SAFT systems, these are primarily upfront costs, meaning that the per unit cost of operating live teledermatology will be highest at the outset and should decrease as more patients are served and dilute the initial set-up costs [40, 43].

Personnel, Training, and Overhead

Given that live teledermatology is operated in real-time like an in-person visit, the costs associated with providing in-person healthcare may still apply, depending on the provider's operating context. These include the cost of clinic space and compensation for dermatologists and other personnel providing and facilitating care [37–39]. Unlike SAFT, patients and providers often do not require special training to engage in live interactive teledermatology.

Cost Savings Associated with Live Interactive Teledermatology

In contrast to SAFT, which primarily produces cost savings by reducing the number of in-person healthcare visits, the cost savings associated with live interactive teledermatology are largely related to decreased societal costs for patients and potentially decreased operating costs for the medical system [36–39, 41, 43].

Patient/Societal Perspective

From the patient perspective, live teledermatology reduces the need for patients to attend an additional in-person visit to receive dermatologic care. Avoiding an in-person clinic visit provides cost savings to the patient given they are not harmed by the potential costs associated with coordinating an in-person visit (e.g., unpaid work leave, childcare, transportation) [39, 41, 44]. The

effects of live teledermatology on wait times for patients seeking dermatologic care have not been analyzed in the literature, and therefore it is unknown whether it would provide cost savings associated with expedited care, such as decreased interim medical visits while waiting to be seen.

HealthCare System Perspective

The economic implications of live teledermatology from the medical system perspective depend upon many factors, including the balance of costs and revenue, as well as the payment model. As with SAFT, costs also depend on the context from which the provider operates (i.e., home or at the office). For closed or capitated medical systems that are paid a fixed amount per patient regardless of the amount of medical care utilized, the cost implications are unclear given cost-effectiveness is not clearly superior or inferior to standard delivery of in-person dermatology care. In fee-for-service payment models, where reimbursement is based upon the number of services or procedures provided, live teledermatology services have historically had better reimbursement rates and fewer insurance restrictions compared to SAFT, with improvements in both areas associated with increased demand and need for telemedicine in the setting of the COVID-19 pandemic [10]. Even with these favorable changes, reimbursement for live interactive teledermatology is generally worse than reimbursement for in-person dermatology visits, especially given the inability to perform office-based procedures [45]. Therefore, from an economic perspective most fee-for-service-based healthcare systems will favor standard in-person visits. Please see Chap. 9 on Regulations and Reimbursement for more information on this topic.

Future Considerations

Implementation of teledermatology systems accelerated in the setting of the COVID-19 pandemic because it provided a safe way for patients to access care without the risk of in-person exposure to healthcare settings. The acceleration was driven by patient and provider demand for virtual care but was also incentivized by government programs that relaxed restrictions regarding who could receive telemedicine services and increased reimbursement [10]. While much has changed in a brief period of time, the fast-moving nature of technology ensures that cost assessments of telemedicine will be forever changing. For instance, the integration of artificial intelligence applications is likely to have a profound impact on the future of telemedicine and its costs [46, 47]. Additionally, changes to future healthcare delivery models, such as the advancement of accountable care organizations, may also have consequences for costs and reimbursements. As we look into the future, it will be important to study the cost-effectiveness of teledermatology in the face of these changing contexts to determine whether they should be considered as permanent fixtures within healthcare.

Conclusion

Cost-effectiveness assessments of teledermatology depend upon the type of teledermatology implemented, the system within which it is implemented, and the beneficiary perspective. Given the countless permutations of different combinations of teledermatology delivery and healthcare payment systems, it is very difficult to provide a "one-size-fits-all" assessment of cost-efficiency. Overall, most studies suggest SAFT produces cost savings, primarily by triaging referrals to reduce the quantity of in-person dermatology visits and by reducing patient costs associated with in-person visit attendance. Live interactive teledermatology has produced mixed results regarding relative cost-effectiveness compared to live in-person visits. However, the available evidence may not represent current-day cost-effectiveness, especially given that live interactive teledermatology has generally been favored in practice given clear, consistent reimbursement practices. Teledermatology can be a cost-effective mechanism for delivering dermatologic care, but limited reimbursement continues to hinder its economic feasibility thereby limiting its implementation.

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References

1. Miller-Breslow AJ, Raizman NM. Physician reimbursement: fee-for-service, accountable care, and the future of bundled payments. Hand Clin. 2020;36(2):189–95.
2. Rosen AR, Littman-Quinn R, Kovarik CL, Lipoff JB. Landscape of business models in teledermatology. Cutis. 2016;97(4):302–4.
3. Armstrong AW, Singh I. Economics of teledermatology—does the math add up? JAMA Dermatol. 2021;157(1):27–8.
4. Sanders GD, Neumann PJ, Basu A, et al. Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. JAMA. 2016;316(10):1093–103.
5. Jiang SW, Flynn MS, Kwock JT, Nicholas MW. Store-and-forward images in teledermatology: narrative literature review. JMIR Dermatol. 2022;5(3):e37517.
6. Rajda J, Seraly MP, Fernandes J, Niejadlik K, Wei H, Fox K, Steinberg G, Paz HL. Impact of direct to consumer store-and-forward teledermatology on access to care, satisfaction, utilization, and costs in a commercial health plan population. Telemed J E Health. 2018;24(2):166–9.
7. Mendonça FI, Lorente-Lavirgen A, Domínguez-Cruz J, Martín-Carrasco P, Hoffner-Zuchelli MV, Monserrat-García MT, Jiménez-Thomas G, López-López R, Pereyra-Rodríguez JJ, Gómez-Thebaut N, García-Ramos C, Dañino-García M, Aguayo-Carreras P, Bernabeu-Wittel J. Direct-to-consumer, store-and-forward teledermatology with dermoscopy using the pharmacist as patient point-of-contact. J Am Pharm Assoc. 2003;61(1):81–6.
8. Resneck JS Jr, Abrouk M, Steuer M, Tam A, Yen A, Lee I, Kovarik CL, Edison KE. Choice, transparency, coordination, and quality among direct-to-consumer telemedicine websites and apps treating skin disease. JAMA Dermatol. 2016;152(7):768–75.
9. Fogel AL, Sarin KY. A survey of direct-to-consumer teledermatology services available to US patients: explosive growth, opportunities and controversy. J Telemed Telecare. 2017;23(1):19–25.
10. Yeboah CB, Harvey N, Krishnan R, Lipoff JB. The impact of COVID-19 on teledermatology: a review. Dermatol Clin. 2021;39(4):599–608.
11. Jiang SW, Flynn MS, Kwock JT, et al. Quality and perceived usefulness of patient-submitted store-and-forward teledermatology images. JAMA Dermatol. 2022;
12. Zakaria A, Miclau TA, Maurer T, Leslie KS, Amerson E. Cost minimization analysis of a teledermatology triage system in a managed care setting. JAMA Dermatol. 2021;157(1):52–8.
13. Datta SK, Warshaw EM, Edison KE, et al. Cost and utility analysis of a store-and-forward teledermatology referral system: a randomized clinical trial. JAMA Dermatol. 2015;151(12):1323–9.
14. Eminović N, Dijkgraaf MG, Berghout RM, Prins AH, Bindels PJ, de Keizer NF. A cost minimisation analysis in teledermatology: model-based approach. BMC Health Serv Res. 2010;10:251.
15. Ferrándiz L, Moreno-Ramírez D, Ruiz-de-Casas A, et al. An economic analysis of presurgical teledermatology in patients with nonmelanoma skin cancer. Actas Dermosifiliogr. 2008;99(10):795–802.
16. Lim D, Oakley AM, Rademaker M. Better, sooner, more convenient: a successful teledermoscopy service. Australas J Dermatol. 2012;53(1):22–5.
17. Livingstone J, Solomon J. An assessment of the cost-effectiveness, safety of referral and patient satisfaction of a general practice teledermatology service. London J Prim Care (Abingdon). 2015;7(2):31–5.
18. Lopez-Villegas A, Bautista-Mesa RJ, Baena-Lopez MA, et al. Economic impact and cost savings of teledermatology units compared to conventional monitoring at hospitals in southern Spain. J Telemed Telecare. 2020;28(6):436–44.
19. Moreno-Ramírez D, Ferrándiz L, Ruiz-de-Casas A, et al. Economic evaluation of a store-and-forward teledermatology system for skin cancer patients. J Telemed Telecare. 2009;15(1):40–5.
20. Morton CA, Downie F, Auld S, et al. Community photo-triage for skin cancer referrals: an aid to service delivery. Clin Exp Dermatol. 2011;36(3):248–54.
21. Os-Medendorp H, Koffijberg H, Kok PCME, et al. E-health in caring for patients with atopic dermatitis: A randomized controlled cost-effectiveness study of internet-guided monitoring and online self-management training. Br J Dermatol. 2012;166:1060–8.
22. Pak HS, Datta SK, Triplett CA, Lindquist JH, Grambow SC, Whited JD. Cost minimization analysis of a store-and-forward teledermatology consult system. Telemed J E Health. 2009;15(2):160–5.
23. Parsi K, Chambers CJ, Armstrong AW. Cost-effectiveness analysis of a patient-centered care model for management of psoriasis. J Am Acad Dermatol. 2012;66(4):563–70.
24. van der Heijden JP, de Keizer NF, Bos JD, Spuls PI, Witkamp L. Teledermatology applied following patient selection by general practitioners in daily practice improves efficiency and quality of care at lower cost. Br J Dermatol. 2011;165(5):1058–65.

25. Vidal-Alaball J, Garcia-Domingo JL, Cuyàs FG, et al. A cost savings analysis of asynchronous teledermatology compared to face-to-face dermatology in Catalonia. BMC Health Serv Res. 2018;18:650.
26. Whited JD, Datta S, Hall RP, et al. An economic analysis of a store and forward teledermatology consult system. Telemed J E Health. 2003;9(4):351–60.
27. Yang X, Barbieri JS, Kovarik CL. Cost analysis of a store-and-forward teledermatology consult system in Philadelphia. J Am Acad Dermatol. 2018;81:758–64.
28. Zarca K, Charrier N, Mahé E, et al. Tele-expertise for diagnosis of skin lesions is cost-effective in a prison setting: A retrospective cohort study of 450 patients. PLoS One. 2018;13:e0204545.
29. Carter ZA, Goldman S, Anderson K, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. JAMA Dermatol. 2017;153(7):644–50.
30. Zakaria A, Maurer T, Su G, Amerson E. Impact of teledermatology on the accessibility and efficiency of dermatology care in an urban safety-net hospital: a pre-post analysis. J Am Acad Dermatol. 2019;81(6):1446–52.
31. Baggot R. Health and health care in Britain. 3rd ed. Basingstoke/New York: Palgrave Macmillan; 2004.
32. Burström B. Market-oriented, Deman-driven health care reforms and equity in health and health care utilization in Sweden. Int J Health Serv. 2009;39(2):271–85.
33. Marchell R, Locatis C, Burgess G, Maisiak R, Liu WL, Ackerman M. Patient and provider satisfaction with teledermatology. Telemed J E Health. 2017;23(8):684–90.
34. Kaunitz G, Yin L, Nagler AR, Sicco KL, Kim RH. Assessing patient satisfaction with live-interactive teledermatology visits during the COVID-19 pandemic: A survey study. Telemed J E Health. 2022;28(4):591–6.
35. Hadeler E, Gitlow H, Nouri K. Definitions, survey methods, and findings of patient satisfaction studies in teledermatology: a systematic review. Arch Dermatol Res. 2021 May;313(4):205–15.
36. Armstrong A, Dorer D, Lugn N, Kvedar J. Economic evaluation of interactive teledermatology compared with conventional care. Telemed J E Health. 2007;13:91–9.
37. Bergmo TS. A cost-minimization analysis of a real-time teledermatology service in northern Norway. J Telemed Telecare. 2000;6:273–7.
38. Burgiss S, Julius C, Watson H, Haynes B, Buonocore E, Smith G. Telemedicine for dermatology care in rural patients. Telemed J. 1997;3:227–33.
39. Loane MA, Oakley A, Rademaker M, et al. A cost-minimization analysis of the societal costs of realtime teledermatology compared with conventional care: results from a randomized controlled trial in New Zealand. J Telemed Telecare. 2001;7:233–8.
40. Loane MA, Bloomer SE, Corbett R, et al. A randomized controlled trial assessing the health economics of realtime teledermatology compared with conventional care: an urban versus rural perspective. J Telemed Telecare. 2001;7:108–18.
41. Oakley A, Kerr P, Duffil M, et al. Patient cost-benefits of realtime teledermatology-a comparison of data from Northern Ireland and New Zealand. J Telemed Telecare. 2000;6:97–101.
42. Persaud DD, Jreige S, Skedgel C, et al. An incremental cost analysis of telehealth in Nova Scotia from a societal perspective. J Telemed Telecare. 2005;11:77–84.
43. Seghers AC, Seng KH, Chio MTW, et al. A prospective study on the use of teledermatology in psychiatric patients with chronic skin diseases. Australas J Dermatol. 2015;56:170–4.
44. Wootton R. Multicentre randomised control trial comparing real time teledermatology with conventional outpatient dermatological care: societal cost-benefit analysis. BMJ. 2000;320:1252–6.
45. Shachar C, Engel J, Elwyn G. Implications for telehealth in a postpandemic future: regulatory and privacy issues. JAMA. 2020;323(23):2375–6. https://doi.org/10.1001/jama.2020.7943.
46. Gomez Rossi J, Rojas-Perilla N, Krois J, Schwendicke F. Cost-effectiveness of artificial Intelligence as a decision-support system applied to the detection and grading of melanoma, dental caries, and diabetic retinopathy. JAMA Netw Open. 2022;5(3):e220269.
47. Conover S. Teledermatology and Artificial Intelligence: Piction Health. iproc. 2022;8(1):e36905.