



Center for
Connected
Health Policy

The National Telehealth Policy Resource Center

Teledermatology Research Catalogue

August 2018

To increase and organize the evidence for the use of telehealth, the Center for Connected Health Policy (CCHP) has been examining published studies that have been designed to measure the use of telehealth in achieving one or more of the goals of the Triple Aim. CCHP has been cataloguing studies published in peer reviewed journals that meet certain criteria. This catalogue of Teledermatology studies is one result.

CCHP employed several search parameters when selecting teledermatology studies. All studies selected were U.S. based, published post 2007, have a sample size of no less than 50 (for studies with control groups, there needed to be a minimum of at least 30 subjects per group), a study period of no less than 6 months and a primary focus on the outcomes (though if all other factors were met and the time period was unspecified, the article was included), quality and or costs of a selected telehealth modality. Retrospective studies and case studies have been included separately, due to the absence of a widely accepted quality assessment scale for these types of studies.

Pub Med, Google Scholar, JSTOR, ProQuest, WorldCat, CINAHL, Science Direct, SAGE and EBSCO were used in the peer-reviewed articles search.

The original catalogue was prepared by Fiona R. Castleberry and the work supervised by Mei Wa Kwong and Christine Calouro. This catalogue was updated in Sept. 2015 by Taylor Whited, July 2016 by Claire Rice, and again in July 2018 by McKenna Thompson.

Control Trial Summaries:

Rajda, J., Seraly, M. P., Fernandes, J., Niejadlik, K., Wei, H., Fox, K., Steinberg, G., Paz, H. L. (2018). Impact of Direct to Consumer Store-and-Forward Teledermatology on Access to Care, Satisfaction, Utilization, and Costs in a Commercial Health Plan Population. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 24, 2, 166-169.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|---------------------------|-------------|--------------------------|---------------------------------|---------|---------|------|
| 6 months | Unspecified (four states) | 152 | Store-and-Forward | Prospective Observational Study | | x | x |

Summary

Purpose: Store-and-forward teledermatology can improve access to dermatology by enabling asynchronous consults. This study assesses it on access, satisfaction, utilization, and costs in a commercial health plan setting.

Methodology: In this prospective observational study with matched control, 47,411 individuals were provided access to teledermatology services staffed by board-certified, licensed dermatologists for 6 months. Two hundred forty-three individuals used the service. One hundred fifty-two participants successfully matched to similar users of in-person services for comparison. Average number of dermatology-related visits and dermatology-related costs in 30, 60, and 90 days post-visit, most frequent diagnoses, time to consult, patient satisfaction, and number of procedures were measured.

Results: Average time to consult for the teledermatology group was 16.31 h. Patient satisfaction was 4.38/5. Total dermatology utilization in the post-visit period for the teledermatology and the control groups respectively was 9 and 21 visits at 30 days ($p = 0.074$), 15 and 46 visits at 60 days ($p = 0.005$), and 26 and 74 at 90 days ($p = 0.001$). The dermatology-related spend for the teledermatology and control groups, respectively, was \$59 and \$113 on the day of the initial consult ($p < 0.01$), \$70 and \$202 for 30 days ($p = 0.03$), \$78 and \$ 221 for 60 days ($p = 0.02$), and \$86 and \$307 for 90 days ($p = 0.08$) following initial visit. Total number of procedures conducted in the control

group at the index visit was 26. In the post-visit period, the total number of procedures in the study and control groups, respectively, were 5 and 15 at 30 days ($p = 0.053$), 10 and 26 at 60 days ($p = 0.088$), and 14 and 32 at 90 days ($p = 0.082$).

Conclusions: Tele dermatology services are accessible within hours and associated with high patient satisfaction. There is no evident increased utilization or costs post-visit.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/28742431>

Kornmehl, H., Singh, S., Johnson, M. A., & Armstrong, A. W. (2017). Direct-Access Online Care for the Management of Atopic Dermatitis: A Randomized Clinical Trial Examining Patient Quality of Life. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 23, 9, 726-732.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|-----------------------------|---------|---------|------|
| 12 months | CA | 156 | Store-and-Forward | Randomized Controlled Trial | x | x | |

Summary

Background: Atopic dermatitis (AD) is a chronic disease requiring regular follow-up. To increase access to dermatological care, online management of AD is being studied. However, a critical knowledge gap exists in determining AD patients' quality of life in direct-to-patient online models. In this study, we examined quality of life in AD patients managed through a direct-access online model.

Materials and Methods: We randomized 156 patients to receiving care through a direct-access online platform or in-person. Patients were seen for six visits over 12 months. At each visit, the patients completed Dermatology Life Quality Index/Children's Dermatology Life Quality Index (DLQI/ CDLQI), and Short Form (SF-12).

Results: Between baseline and 12 months, the mean (standard deviation, SD) within-group difference in DLQI score in the online group was 4.1 (–2.3); for the in-person group, the within-group difference was 4.8 (–2.7). The mean (SD) within-group difference in CDLQI score in the online group was 4.7 (–2.8); for the in-person group, the within-group difference was 4.9 (–3.1). The mean (SD) within-group difference in physical component score (PCS) and mental component score (MCS) SF-12 scores in the online group was 6.5 (–3.8) and 8.6 (–4.3); for the in-person group, it was 6.8 (–3.2) and 9.1(–3.8), respectively. The difference in the change in DLQI, CDLQI, SF-12 PCS, and SF-12MCS scores between the two groups was 0.72 (95% confidence interval [90% CI], –0.97 to 2.41), 0.23 (90% CI, –2.21 to 2.67), 0.34 (90% CI, –1.16 to 1.84), and 0.51 (90% CI, –1.11 to 2.13), respectively. All differences were contained within their equivalence margins.

Conclusion: Adult and pediatric AD patients receiving direct access online care had equivalent quality of life outcomes as those see in-person. The direct-access online model has the potential to increase access to care for patients with chronic skin diseases.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/25338198>

Marchell, R., Locatis, C., Burges, G., Maisiak, R., Liu, W. L., & Ackerman, M. (2017). Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 23, 3, 213-218.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|-------------------------------|-----------------------------------|---------|---------|------|
| Unspecified | SC | 214 | Store-and-Forward; Live Video | Quasi-randomized controlled trial | | x | |

Summary

Background: There is little teledermatology research directly comparing remote methods, even less research with two in-person

dermatologist agreement providing a baseline for comparing remote methods, and no research using high definition video as a live interactive method.

Objective: To compare in-person consultations with store-and-forward and live interactive methods, the latter having two levels of image quality.

Methods: A controlled study was conducted where patients were examined in-person, by high definition video, and by store-and-forward methods. The order patients experienced methods and residents assigned methods rotated, although an attending always saw patients in-person. The type of high definition video employed, lower resolution compressed or higher resolution uncompressed, was alternated between clinics. Primary and differential diagnoses, biopsy recommendations, and diagnostic and biopsy confidence ratings were recorded.

Results: Concordance and confidence were significantly better for in-person versus remote methods and biopsy recommendations were lower. Store-and-forward and higher resolution uncompressed video results were similar and better than those for lower resolution compressed video.

Limitations: Dermatology residents took store-and-forward photos and their quality was likely superior to those normally taken in practice. There were variations in expertise between the attending and second and third year residents.

Conclusion: The superiority of in-person consultations suggests the tendencies to order more biopsies or still see patients in-person are often justified in teledermatology and that high resolution uncompressed video can close the resolution gap between store-and-forward and live interactive methods.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/27705083>

Nelson, C. A., Takeshita, J., Wanat, K. A., Bream, K. D. W., Holmes, J. H., Koenig, H. C., Roth, R. R., Kovarik, C. L. (2016). Impact of store-and-forward (SAF) teledermatology on outpatient dermatologic care: A prospective study in an underserved urban primary care

setting. *Journal of the American Academy of Dermatology*, 74, 3, 484.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|-------------------|---------|---------|------|
| 11 months | PA | 196 | Store-and-Forward | Prospective Study | x | x | |

Summary

Background: The clinical value of teledermatology in the primary care setting remains relatively unknown.

Objective: We sought to determine the impact of teledermatology on outpatient diagnosis, management, and access to dermatologic care in a resource-poor primary care setting.

Methods: We performed a 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. We assessed diagnostic and management concordance between primary care providers and dermatologists, time to consult completion, anticipated level of dermatology input in the absence of teledermatology, and number of consults managed with teledermatology alone.

Results: The study included 196 consults encompassing 206 dermatologic conditions. Diagnoses and management plans of primary care providers and dermatologists were fully concordant for 22% and 23% of conditions, respectively. The median time to consult completion was 14 (interquartile range 3-28) hours. At least 61% of consults would not otherwise have received dermatology input, and 77% of consults were managed with teledermatology alone.

Limitations: Lack of a diagnostic gold standard, limited patient follow-up, and uncertain generalizability are limitations.

Conclusion: Teledermatology is an innovative and impactful modality for delivering dermatologic care to outpatients in resource-poor primary care settings.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/26679528>

Datta, S., Warshaw, E., Edison, K., Kapur, K., Thottapurathu, L., Moritz, T., Reda, D., Whited, J. (2015). Cost and Utility Analysis of a Store-and-Forward Teledermatology Referral System: A Randomized Control Trial. *JAMA Dermatology*, 151(12), 1323-1329.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|--------|-------------|--------------------------|--------------------------------|---------|---------|------|
| 6 years | MO, MN | 391 | Store-and-Forward | Randomized Control Trial (RCT) | | | x |

Summary

Importance: The costs and utility of teledermatology are important features of implementation. Such an analysis requires a description of the perspective of the entity that will bear the cost.

Objective: To assess the costs and utility of a store-and-forward teledermatology referral process compared with a conventional referral process from the perspectives of the Department of Veterans Affairs (VA) and society.

Design, Setting, and Participants: Three hundred ninety-one randomized participants were referred from remote sites of primary care to the dermatology services of 2 VA medical facilities for ambulatory skin conditions from December 2008 through June 2010, and follow-up was completed in March 2011. The time trade-off utility measures and costs were collected during a 9-month period among participants in a 2-site parallel group randomized clinical trial. The perspectives of the VA and society were evaluated. The multiple imputation procedure or weighted means were used for missing data elements. Data were analyzed from January to July 2014.

Interventions: Referrals were managed using store-and-forward teledermatology or a conventional text-based referral process.

Main Outcomes and Measures: Total costs from the perspectives of the VA and society incurred during the 9-month follow-up were used

to derive per-participant costs. Utility, using the time trade-off method, was the measure of effectiveness.

Results: From the VA perspective, the total cost for conventional referrals was \$66,145 (minimum, \$58,697; maximum, \$71,635), or \$338 (SD, \$291) per participant (196 participants); the total cost for teledermatology referrals was \$59,917 (minimum, \$51,794; maximum, \$70,398), or \$308 (SD, \$298) per participant (195 participants). The \$30 difference in per-participant cost was not statistically significant (95% CI, -\$79 to \$20). From the societal perspective, the total cost for conventional referrals was \$106,194 (minimum, \$98,746; maximum, \$111,684), or \$542 (SD, \$403) per participant (196 participants); the total cost for teledermatology referrals was \$89,523 (minimum, \$81,400; maximum, \$100,400) or \$460 (SD, \$428) per participant. This \$82 difference in per-participant cost was statistically significant (95% CI, -\$12 to -\$152). From baseline to the 9-month follow-up, the time trade-off utility value improved by 0.02 in the conventional referral group and 0.03 in the teledermatology group. This difference was not statistically significant (P = .50).

Conclusions and Relevance: Compared with conventional referrals, store-and-forward teledermatology referrals were performed at a comparable cost (VA perspective) or at a lower cost (societal perspective) with no evidence of a difference in utility as measured by the time trade-off method.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/26375589>

Warshaw, EM., Gravely, AA., Nelson, DB. (2015). Reliability of store and forward teledermatology for skin neoplasms. *American Academy of Dermatology*, 72(43): 426-435.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|--|---------|---------|------|
| Unstated | MN | 2152 | Store-and-Forward | Cross-sectional, repeated measures equivalence | x | x | |

Summary

Background: Teledermatology may be less optimal for skin neoplasms than for rashes.

Objectives: We sought to determine agreement for skin neoplasms.

Methods: This was a repeated measures study. Each lesion was examined by a clinic dermatologist and a teledermatologist; both generated a primary diagnosis, up to 2 differential diagnoses, and management. Macro images and polarized light dermoscopy images were obtained; for pigmented lesions only, contact immersion dermoscopy image was obtained.

Results: There were 3,021 lesions in 2,152 patients. Of 1,685 biopsied lesions, there were 410 basal cell carcinomas (24%), 240 squamous cell carcinomas (14%), and 41 melanomas (2.4%). Agreement was fair to substantial for primary diagnosis (45.7%-80.1%; kappa 0.32-0.62), substantial to almost perfect for aggregated diagnoses (primary plus differential; 78.6%-93.9%; kappa 0.77-0.90), and fair for management (66.7%-86.1%; kappa 0.28-0.41). Diagnostic agreement rates were higher for pigmented lesions (52.8%-93.9%; kappa 0.44-0.90) than nonpigmented lesions (47.7%-87.3%; kappa 0.32-0.86), whereas the reverse was found for management agreement (pigmented: 66.7%-79.8%, kappa 0.19-0.35 vs nonpigmented: 72.0%-86.1%, kappa 0.38-0.41). Agreement rates using macro images were similar to polarized light dermoscopy; contact immersion dermoscopy, however, significantly improved rates for pigmented lesions.

Limitations: We studied a homogeneous population.

Conclusions: Diagnostic agreement was moderate to almost perfect whereas management agreement was fair. Polarized light dermoscopy increased rates modestly whereas contact immersion dermoscopy significantly increased rates for pigmented lesions.

Access: [http://www.jaad.org/article/S0190-9622\(14\)02125-2/abstract](http://www.jaad.org/article/S0190-9622(14)02125-2/abstract)

Barbieri, J, BA; Nelson, C, BA; James, W, MD; Margolis, D, MD, MDCE, PD; Littman-Quinn, R, BA; Kovarik, C, MD and Rosenbach, M, MD. (2014). The reliability of teledermatology to triage inpatient dermatology consultations. *JAMA Dermatology*, 150(4), 419-424.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|---------------------------|---------|---------|------|
| 8 months | PA | 50 | Store-and-Forward | Prospective Control Trial | x | x | |

Summary

Importance: Many hospitals do not have inpatient dermatologic consultative services, and most have reduced availability of services during off-hours. Dermatologists based in outpatient settings can find it challenging to determine the urgency with which they need to evaluate inpatients when consultations are requested. Teledermatology may provide a valuable mechanism for dermatologists to triage inpatient consultations and increase efficiency, thereby expanding access to specialized care for hospitalized patients.

Objective: To evaluate whether a store-and-forward teledermatology system is reliable for the initial triage of inpatient dermatology consultations.

Design, Setting, and Participants: Prospective study of 50 consenting adult patients, hospitalized for any indication, for whom an inpatient dermatology consultation was requested between September 1, 2012, and April 31, 2013, at the Hospital of the University of Pennsylvania, an academic medical center. The participants were evaluated separately by both an in-person dermatologist and 2 independent teledermatologists.

Main Outcomes and Measures: The primary study outcomes were the initial triage and decision to biopsy concordance between in-person and teledermatology evaluations.

Results: Triage decisions were as follows: if the in-person dermatologist recommended the patient be seen the same day, the teledermatologist agreed in 90% of the consultations. If the in-person dermatologist recommended a biopsy, the teledermatologist agreed in 95% of cases on average. When the teledermatologist did not choose the same course of action, there was substantial diagnostic agreement between the teledermatologist and the in-person dermatologist. The Kendall τ rank correlation coefficients for initial triage concordance between the in-person dermatologist and teledermatologists were 0.41 and 0.48. The Cohen κ coefficients for decision to biopsy concordance were 0.35 and 0.61. The teledermatologists were able to triage 60% of consultations to be seen the next day or later. The teledermatologists were able to triage, on average, 10% of patients to be seen as outpatients after discharge.

Conclusions and Relevance: Teledermatology is reliable for the triage of inpatient dermatology consultations and has the potential to improve efficiency.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/24522374>

McFarland, L, PhD; Raugi, G, MD and Reiber, G, PhD. (2013). Primary care provider and imaging technician satisfaction with a teledermatology project in rural Veterans Health Administration clinics. *Telemedicine and e-Health*, 19(11), 815-825.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|----------------|--|--------------------------|--------------------------|---------|---------|------|
| 3 years | AK, ID, OR, WA | 16,194 tele-dermatology consults, 9,720 patients | Store-and-Forward | Randomized Control Trial | x | x | x |

Summary

Objective: Assessment of a multisite rural teledermatology project between 2009 and 2012 in four Pacific Northwest states that trained primary care providers and imaging technicians in state-of-the-art techniques of telemedicine.

Materials and Methods: In 2012, we assessed provider and imaging technician acceptability and satisfaction with a 32-item survey instrument based on the Patient Satisfaction Questionnaire developed by Ware et al. (Eval Program Plann 1983;6:247-63) and modified for telemedicine by Kraai et al. (J Card Fail 2011;17:684-690). Survey questions covered eight satisfaction domains: interpersonal manner, technical quality, accessibility, finances, efficacy, continuity, physical environment, and availability.

Results: Overall, 71% of the primary care providers and 94% of the imaging technicians reported being satisfied or extremely satisfied with the teledermatology project. Most (95%) providers found the continuing education classes on dermatology diagnosis and treatment

topics useful, and 86% reported teledermatology was a good addition to regular patient services. Most (97%) of the imaging technicians were satisfied with the ability of teledermatology to improve the description of dermatology conditions using images of the lesions or rashes, and 91% were satisfied with the convenience of teledermatology. Challenges reported by both providers and imaging technicians include an increase in workload due to more patient visits related to dermatology care and limited information technology support.

Conclusions: Given the Veterans Health Administration's initiatives to promote accessible health care to underserved Veterans using telehealth, these findings can inform future program designs for teledermatology.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/24053115>

Whited, J, MD, MHS; Warshaw, E, MD, MS; Kapur, K, PhD; Edison, K, MD; Thottapurathu, L, MS; Raju, S, MD; Cook, B, MD; Engasser, H, MD; Pullen, S, MD; Moritz, S; Datta, S; Marty, L; Foman, N; Suwattee, P; Ward, D and Reda, D. (2013). Clinical course outcomes for store and forward teledermatology versus conventional consultation: a randomized trial. *Journal of Telemedicine and Telecare*, 19: 197-204

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|-------------------|--------|-------------|--------------------------|--------------------------|---------|---------|------|
| Does not specify. | MO, MN | 261 | Store-and-Forward | Randomized Control Trial | x | x | |

Summary

We assessed the clinical course of patients after store and forward teledermatology in comparison with conventional consultations. Patients being referred from primary care to dermatology clinics were randomly assigned to teledermatology or a conventional consultation. A total of 392 patients were randomized; 261 patients completed the study and were included in the analysis. Their clinical course was rated on a five-point scale by a panel of three dermatologists, blinded to study assignment, who reviewed serial digital image sets. The clinical course was assessed by comparing images sets between baseline and first clinic visit (if one occurred) and between

baseline and nine months. There was no evidence to suggest a difference between the two groups in either clinical course between baseline and nine months post-referral (P = 0.88) or between baseline and the first dermatology clinic visit (P = 0.65). Among teledermatology referrals, subsequent presentation for an in-person dermatology clinic visit was significantly correlated with clinical course (P = 0.023). Store and forward teledermatology did not result in a significant difference in clinical course at either of two post-referral time periods.

Access: <http://jtt.sagepub.com/content/19/4/197.full.pdf+html>

Whited, J, MD, MHS; Warshaw, E, MD, MS; Edison, K, MD; Kapur, K, PhD; Thottapurathu, L, MS; Raju, S, MD; Cook, B, MD; Engasser, H, MD; Pullen, S, MD; Parks, P, CMA; Sindowski, T, BS; Motyka, D, BS; Brown, R, BS; Moritz, T, MS; Datta, S, MBA, PhD; Chren, M, MD; Marty, L, DO; Reda, D, PhD. (2013). Effect of Store and Forward Teledermatology on Quality of Life. *JAMA Dermatology*, 150(4), 419-424.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------------|--------------------------|---------|---------|------|
| 9 months | MO,MN | 326 | Digital image and text history | Randomized Control Trial | x | x | |

Summary

Importance: Although research on quality of life and dermatologic conditions is well represented in the literature, information on teledermatology's effect on quality of life is virtually absent.

Objective: To determine the effect of store and forward teledermatology on quality of life.

Design: Two-site, parallel-group, superiority randomized controlled trial.

Setting: Dermatology clinics and affiliated sites of primary care at 2 US Department of Veterans Affairs medical facilities.

Participants: Patients being referred to a dermatology clinic were randomly assigned, stratified by site, to teledermatology or the conventional consultation process. Among the 392 patients who met the inclusion criteria and were randomized, 326 completed the allocated intervention and were included in the analysis.

Interventions: Store and forward teledermatology (digital images and a standardized history) or conventional text-based consultation processes were used to manage the dermatology consultations. Patients were followed up for 9 months.

Main Outcome Measurements: The primary end point was change in Skindex-16 scores, a skin-specific quality-of-life instrument, between baseline and 9 months. A secondary end point was change in Skindex-16 scores between baseline and 3 months.

Results: Patients in both randomization groups demonstrated a clinically significant improvement in Skindex-16 scores between baseline and 9 months with no significant difference by randomization group ($P = .66$, composite score). No significant difference in Skindex-16 scores by randomization group between baseline and 3 months was found ($P = .39$, composite score).

Conclusions: Compared with the conventional consultation process, store and forward teledermatology did not result in a statistically significant difference in skin-related quality of life at 3 or 9 months after referral.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/23426111>

Hsueh, M, RN; Eastman, K, MD; McFarland, L, PhD; and Raugi, G, MD, PhD and Reiber, G, MPH, PhD. (2012). Teledermatology patient satisfaction in the Pacific Northwest. *Telemedicine and e-Health*, 18(5), 377-381.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|----------------|---|--------------------------|--------------------------|---------|---------|------|
| 3 years | AK, ID, OR, WA | 16,194 tele-dermatology consults, 9,720 | Store-and-Forward | Randomized Control Trial | x | x | x |

| | | | | | | | |
|---|--|----------|--|--|--|--|--|
| | | patients | | | | | |
| Summary | | | | | | | |
| <p>Background: The aim of this quality improvement project is to assess patient satisfaction with a store-and-forward teledermatology project and to identify factors associated with patient satisfaction and dissatisfaction.</p> <p>Subjects and Methods: Veterans receiving care in rural clinics in the Pacific Northwest were surveyed using a 5-point Likert scale about satisfaction with face-to-face care for a skin complaint prior to any teledermatology exposure. One year later, veterans in the same rural clinics were surveyed about satisfaction with teledermatology care using a more comprehensive survey. Ninety-six patients completed the face-to-face satisfaction survey questions, and 501 completed the teledermatology satisfaction survey.</p> <p>Results: Most (78%) of surveyed patients were highly satisfied or satisfied with face-to-face dermatology care. After 1 year of teledermatology, 77% of patients were highly satisfied or satisfied with teledermatology care. The mean patient satisfaction score for teledermatology was equivalent to face-to-face care (4.1±1.2 and 4.3±1.0, p=0.4). Factors associated with teledermatology patient satisfaction included short wait times for initial consultation, a perception that the initial wait time was not too long, a perception that the skin condition was properly treated, and the belief that adequate follow-up was received. Factors associated with teledermatology patient dissatisfaction included perceptions that the skin condition was not properly treated and that inadequate follow-up was received.</p> <p>Conclusions: Teledermatology was widely accepted by the majority of patients receiving care at rural clinics. Patient satisfaction with care received through teledermatology was equivalent to that with face-to-face dermatology.</p> | | | | | | | |
| <p>Access: http://online.liebertpub.com/doi/pdf/10.1089/tmj.2011.0181</p> | | | | | | | |

| <p>Lamel, SA., Haldeman, KM., Ely, H., Kovarik, CL., Pak, H., Armstrong, AW. (2011). Application of mobile teledermatology for skin cancer screening. <i>Journal for the American Academy of Dermatology</i>, 67(4), 577-581.</p> | | | | | | | |
|---|-------|-------------|--------------------------|--------|---------|---------|------|
| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
| | | | | | | | |

| | | | | | | | |
|---------|----|----|---------|---|--|---|--|
| Unclear | CA | 86 | mHealth | Mixed-model logistic regression analytical method | | x | |
|---------|----|----|---------|---|--|---|--|

Summary

Background: With advancements in mobile technology, cellular phone-based store-and-forward teledermatology may be applied to skin cancer screening.

Objective: We sought to determine diagnostic and management concordance between in-person and teledermatology evaluations for patients at skin cancer screening whose clinical images and history were transmitted through mobile phones.

Methods: A total of 86 patients with 137 skin lesions presented to a skin cancer screening event in California. These patients' clinical history and skin images were captured by a software-enabled mobile phone. Patients were assessed separately by an in-person dermatologist and a teledermatologist, who evaluated the mobile phone-- transmitted history and images. Diagnostic and management concordance was determined between the in-person and teledermatology evaluations.

Results: The primary categorical diagnostic concordance was 82% between the in-person dermatologist and the teledermatologist (95% confidence interval 0.73-0.89), with a Kappa coefficient of 0.62 indicating good agreement. The aggregated diagnostic concordance between the in-person dermatologist and the teledermatologist was 62% (95% confidence interval 0.51-0.71), with Kappa coefficient of 0.60 indicating good agreement. Management concordance between the in-person dermatologist and the teledermatologist was 81% (95% confidence interval 0.72-0.88), with a Kappa coefficient of 0.57, which indicates moderate agreement between the dermatologists. Multivariate analysis showed that older age and presentation of atypical nevus were significantly associated with disagreement in diagnosis between the teledermatologist and in-person dermatologist, after adjusting for other factors.

Limitations: Dermatoscopic images were not captured via mobile phones, which might improve diagnostic accuracy.

Conclusion: Mobile teledermatology using cellular phones is an innovative and convenient modality of providing dermatologic

consultations for skin cancer screening.

Access: <http://dx.doi.org/10.1016/j.jaad.2011.11.957>

Koch, L, MD; Lampros, J, MD; Delong, J, MD, MPH; Chen, S, MD, MS, Woosley, J, MD, PhD, Hood, A, MD. (2009). Randomized comparison of virtual microscopy and traditional glass microscopy in diagnostic accuracy among dermatology and pathology residents. *Human Pathology*, 40(5), 662-667.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|---|---|--|--------------------------|--|---------|---------|------|
| Unclear (Says the test was administered at the end of the academic term. Does not specify exact time frame) | Accredited medical schools across the U.S. (Report does not specify which ones) | 132 dermatology and pathology residents from 14 institutions | Virtual Microscopy | Randomized Comparison of Virtual Microscopy and Traditional Glass Slides | x | x | x |

Summary

Virtual microscopy is being used in medical schools to teach histology and pathology. It is also being used in resident education, in-training examinations (dermatology), and certification examinations (pathology). There are, however, few studies comparing its diagnostic accuracy and acceptability compared with traditional glass slides. This study sought to compare residents' abilities in diagnosing dermatopathology disorders in 2 image formats (traditional microscopic slides and whole mount digitized images) and to

assess their perceptions of virtual microscopy in dermatopathology. Residents in dermatology and pathology training programs at 14 institutions were given a randomized combination of 20 virtual and glass slides and were asked to identify the diagnoses from multiple foils. They were then asked to give their impressions about the virtual images. Descriptive data analysis and comparison of groups using Pearson chi(2) and Fisher exact tests for categorical variables and Student t test for continuous variables were performed. Residents in dermatology and pathology performed similarly in diagnosing dermatopathology disorders using virtual slides or glass slides (mean [SD] correct for virtual versus glass, 5.48 (1.72) versus 5.57 (2.06); P = .70). The order of administration of virtual versus glass slides did not affect the percentage of questions answered correctly. Most residents supported the use of virtual microscopy as a learning aid, whereas fewer favored its use in testing (79% versus 44%, respectively). Residents performed similarly in making dermatologic diagnoses using virtual slides compared with glass slides despite the residents' preference for the latter.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/19144382>

Warshaw, E, MD, MS; Lederle, F, MD; Grill, J, MS; Gravely, A, MA; Bangerter, A, BS; Fortier, L, MA; Bohjanen, K, MD; Chen, K, MD; Lee, P MD, PhD; Rabinovitz, H, MD, Johr, R, MD; Kayne, V, MD; Bowers, S, MD; Wenner, R, MD; Askari, S, MD; Kedrowski, D, RN; and Nelson, D, PhD. (2009). Accuracy of teledermatology for pigmented neoplasms. *Journal of the American Academy of Dermatology*, 61(5), 753-765

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|---------------|---------|---------|------|
| 3 years | MN | 542 | Store-and-Forward | Control Trial | x | x | |

Summary

Background: Accurate diagnosis and management of pigmented lesions is critical because of the morbidity and mortality associated with melanoma.

Objective: We sought to compare accuracy of store-and-forward teledermatology for pigmented neoplasms with standard, in-person clinic dermatology.

Methods: We conducted a repeated measures equivalence trial involving veterans with pigmented skin neoplasms. Each lesion was evaluated by a clinic dermatologist and a teledermatologist; both generated a primary diagnosis, up to two differential diagnoses, and a management plan. The primary outcome was aggregated diagnostic accuracy (match of any chosen diagnosis with histopathology). We also compared the severity of inappropriately managed lesions and, for teledermatology, evaluated the incremental change in accuracy when polarized light dermatoscopy or contact immersion dermatoscopy images were viewed.

Results: We enrolled 542 patients with pigmented lesions, most were male (96%) and Caucasian (97%). The aggregated diagnostic accuracy rates for teledermatology (macro images, polarized light dermatoscopy, and contact immersion dermatoscopy) were not equivalent (95% confidence interval for difference within 610%) and were inferior (95% confidence interval lower bound \10%) to clinic dermatology. In general, the addition of dermatoscopic images did not significantly change teledermatology diagnostic accuracy rates. In contrast to diagnostic accuracy, rates of appropriate management plans for teledermatology were superior and/or equivalent to clinic dermatology (all image types: all lesions, and benign lesions). However, for the subgroup of malignant lesions (n = 124), the rate of appropriate management was significantly worse for teledermatology than for clinic dermatology (all image types). Up to 7 of 36 index melanomas would have been mismanaged via teledermatology.

Limitations: Nondiverse study population and relatively small number of melanomas were limitations.

Conclusions: In general, the diagnostic accuracy of teledermatology was inferior whereas management was equivalent to clinic dermatology. However, for the important subgroup of malignant pigmented lesions, both diagnostic and management accuracy of teledermatology was generally inferior to clinic dermatology and up to 7 of 36 index melanomas would have been mismanaged via teledermatology. Teledermatology and teledermatoscopy should be used with caution for patients with suspected malignant pigmented lesions.

Access: [http://www.jaad.org/article/S0190-9622\(09\)00519-2/abstract](http://www.jaad.org/article/S0190-9622(09)00519-2/abstract)

Retrospective and Case Study Summaries:

Naka, F., Lu, J., Porto, A., Villagra, J., Wu, Z. H., & Anderson, D. (2018). Impact of dermatology eConsults on access to care and skin cancer screening in underserved populations: A model for tele dermatology services in community health centers. *Journal of the American Academy of Dermatology*, 78, 2, 293-302.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|--|---------|---------|------|
| 18 months | CT | 2385 | Store-and-Forward | Descriptive Retrospective Cohort Study | x | x | |

Summary

Background: The clinical outcome of tele dermatology with dermoscopy in large-scale primary care networks remains unclear.

Objective: We evaluate the impact of implementing a tele dermatology consultation program with dermoscopy on a statewide scale, focusing on access to care and skin cancer screening for medically underserved populations.

Methods: Descriptive retrospective cohort study of 2385 dermatology referrals from primary care from June 2014 through November 2015.

Results: Before implementation of electronic consultations (eConsults), access to dermatology was limited; only 139 (11%) of 1258 referrals resulted in a confirmed appointment with a median wait time of 77 days. Post implementation, 499 of 1127 consults (44%) were sent electronically, and of those, 16% required a face-to-face visit with a median wait time of 28 days. Ten malignancies were identified via eConsults. Overall consult volume remained stable pre- and post-eConsult implementation.

Limitations: We evaluated eConsults in medically underserved populations seeking care at community health centers. Results might not

be generalizable to other populations or in other settings.

Conclusion: eConsults increase access to dermatologic care and reduce wait times for patients receiving medical care at community health centers. Implementing dermoscopy into teledermatology could increase access to skin cancer screening and treatment for medically disadvantaged populations/

Access: <https://www.ncbi.nlm.nih.gov/pubmed/29061478>

Creighton-Smith, M., Murgia, R. D. ., Konnikov, N., Dornelles, A., Garber, C., & Nguyen, B. T. (2017). Incidence of melanoma and keratinocytic carcinomas in patients evaluated by store-and-forward teledermatology vs. dermatology clinic. *International Journal of Dermatology*, 56, 10, 1026-1031.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|----------------------------|---------|---------|------|
| 12 months | MA | 1021 | Store-and-Forward | Retrospective Cohort Study | x | x | |

Summary

Background: It is unclear whether incidence of detected skin cancer in patients evaluated by store-and-forward teledermatology (SAF) vs. face-to-face consultation (F2F) significantly differs, and whether such differences are because of variations in patient demographics, diagnostic accuracy, or both.

Methods: This retrospective cohort study compares patient skin cancer risk profile, pre-post biopsy diagnostic accuracy, and detection rates of any skin cancer, melanoma, and keratinocytic carcinoma between all SAF teledermatology patients and a subset of randomly selected F2F consultations at VA-Boston Healthcare System in 2014.

Results: Patients in the teledermatology (n = 434) and F2F visit cohorts (n = 587) had similar baseline demographics except a higher proportion of F2F patients had prior history of skin cancer, 22% (131/587) vs. 10% (45/434), P < 0.001, and received biopsies, 27.2% (160/587) vs. 11.5% (50/434), P < 0.001. When adjusted for age, immunosuppression, and personal and family history of skin cancer, there were no significant differences between the two cohorts in detection rates for any skin cancer (9.5% vs. 5.8%, P = 0.3), melanoma (0.6% vs. 0%, P = N/A), or keratinocytic carcinoma (8.5% vs. 5.5%, P = 0.7). The two cohorts also had similar pre-post biopsy perfect diagnostic concordance, time from initial consult request to biopsy (45.5 d vs. 47.3 d, P = 0.8), and time from biopsy to definitive treatment (67.5 d vs. 65.4 d, P = 0.8).

Conclusion: F2F patients were more likely to have prior history of skin cancer and receive biopsies. When adjusted for presence of skin cancer risk factors, incidence of detected melanoma, keratinocytic carcinoma, and any skin cancer was similar between SAF teledermatology and F2F patients.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/28631824>

Wang, M., Gendreau, J. L., Gemelas, J., Capulong, D., Lau, C., Mata-Diaz, S., Bratten, D. M., Raugi, G. J. (2017). Diagnosis and Management of Malignant Melanoma in Store-and-Forward Teledermatology. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 23, 11, 877-880.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|-------------------|-------|-------------|-------------------------------|----------------------------|---------|---------|------|
| 2 years, 6 months | WA | 61 | Store-and-Forward; Live Video | Retrospective Chart Review | x | x | |

Summary

Background: Published studies have led to concern that store-and-forward teledermatology (SFT) diagnosis and management of

melanomas may be inferior to face-to-face (FTF) dermatology care.

Introduction: To ascertain the frequency of correctly managed and diagnosed melanomas within a population of veterans in Veterans Integrated Service Network 20 SFT.

Materials and Methods: We conducted a retrospective chart review of 7,960 veterans seen by SFT between July 1, 2009 and December 31, 2011.

Results: Of the 61 veterans that met inclusion and exclusion criteria, 45 (74%) melanomas were correctly diagnosed and 57 (93%) were correctly managed.

Discussion: Diagnostic and management accuracy of SFT is comparable to FTF. Incorrect diagnosis or management of melanomas did not prove to have significant consequences for patient care. Cases subject to analysis of this study are not demographically representative of the general population.

Conclusion: Diagnosis and management of melanoma in SFT is comparable to FTF care.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/28498031>

Raugi, G. J., Nelson, W., Miethke, M., Boyd, M., Markham, C., Dougall, B., Bratten, D., Comer, T. (2016). Tele dermatology Implementation in a VHA Secondary Treatment Facility Improves Access to Face-to-Face Care. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 22, 1, 12-7.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|------------------------|---------|---------|------|
| 1 year, 6 | WA | 433 | Store-and-Forward | Retrospective Analysis | | x | |

| | | | | | | | |
|--------|--|--|--|--|--|--|--|
| months | | | | | | | |
|--------|--|--|--|--|--|--|--|

Summary

Background: Tele dermatology is a mainstream modality for delivering care in the Veterans Health Administration, especially in rural areas where access to traditional dermatology care is constrained. Previous investigations of the effect of tele dermatology on improving patient access have focused largely on the metrics of visits avoided. However, the effect of tele dermatology on improving patient access to face-to-face dermatology has not been well documented. The purpose of this study was to assess the impact of the implementation of store-and-forward tele dermatology on access to face-to-face dermatology at the Mann-Grandstaff Spokane Veterans Administration (VA) Medical Center in Spokane, WA.

Materials and Methods: Completed requests for dermatology and tele dermatology consultation originating from the Spokane main facility from January 1, 2012 through June 30, 2013 were obtained from the Corporate Data Warehouse by SQL query. The numbers of consult requests and wait times for care for overall dermatology, face-to-face dermatology, and tele dermatology were compared across the baseline, transition, and intervention periods.

Results: 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 (tele dermatology 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.

Conclusions: Implementation of a tele dermatology program at the Mann-Grandstaff Spokane VA Medical Center improved access to face-to-face dermatology care.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/26393782>

Uscher-Pines, L., Malsberger, R., Burgette, L., Mulcahy, A., & Mehrotra, A. (2016). Effect of Teledermatology on Access to Dermatology Care Among Medicaid Enrollees. *Jama Dermatology*, 152, 8, 905-12.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|-------------------|-------|-------------|--------------------------|-----------------------|---------|---------|------|
| 2 years, 9 months | CA | 382,801 | Store-and-Forward | Cross-sectional study | | x | |

Summary

Importance: Access to specialists such as dermatologists is often limited for Medicaid enrollees. Teledermatology has been promoted as a potential solution; however, its effect on access to care at the population level has rarely been assessed.

Objectives: To evaluate the effect of teledermatology on the number of Medicaid enrollees who received dermatology care and to describe which patients were most likely to be referred to teledermatology.

Design, Setting, and Participants: Claims data from a large California Medicaid managed care plan that began offering teledermatology as a covered service in April 2012 were analyzed. The plan enrolled 382 801 patients in California’s Central Valley, including 108 480 newly enrolled patients who obtained coverage after the implementation of the Affordable Care Act. 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, and assessed from March 1 to October 15, 2015.

Main Outcomes and Measures: The percentage of patients with at least 1 visit to a dermatologist (including in-person and teledermatology visits) and total visits with dermatologists (including in-person and teledermatology visits) per 1000 patients.

Results: Of the 382 801 patients enrolled for at least 1 day from 2012 to 2014, 8614 (2.2%) had 1 or more visits with a dermatologist. Of all patients who visited a dermatologist, 48.5% received care via teledermatology. Among the patients newly enrolled in Medicaid, 75.7% (1474 of 1947) of those who visited a dermatologist received care via teledermatology. Primary care practices that engaged in

tele dermatology had a 63.8% increase in the fraction of patients visiting a dermatologist (vs 20.5% in other practices; $P < .01$). Compared with in-person dermatology, tele dermatology served more patients younger vs older than 17 years (2600 of 4427 [58.7%] vs 1404 of 4187 [33.5%]), male patients (1849 of 4427 [41.8%] vs 1526 of 4187 [36.4%]), nonwhite patients (2779 of 4188 [66.4%] vs 1844 of 3478 [53.0%]), and individuals without comorbid conditions (1795 of 2464 [72.8%] vs 1978 of 3024 [65.4%]) ($P < .001$ for all comparisons). Conditions managed across settings varied; tele dermatology physicians were more likely to care for viral skin lesions and acne (3405 of 7287 visits [46.7%]), whereas in-person dermatologists were more likely to care for psoriasis and skin neoplasms (10 062 of 27 347 visits [36.8%]).

Conclusions and Relevance: The offering of tele dermatology appeared to improve access to dermatology care among Medicaid enrollees and played an especially important role for the newly enrolled.

Access: <https://www.ncbi.nlm.nih.gov/pubmed/27144986>

Karavan, M; Compton, N; Knezevich, S; Raugi, G; Kodama, S; Taylor, L and Reiber, G (2014). Tele dermatology in the diagnosis of melanoma. *Journal of Telemedicine and Telecare*, 20(1), 18-23.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|--------------------|-------------|--------------------------|---------------------|---------|---------|------|
| 3 years | Pacific North West | 529 | Store-and-Forward | Retrospective Study | x | x | |

Summary

We conducted a retrospective chart review of US Veterans in the Pacific Northwest area to compute melanoma incidence and Breslow depth at diagnosis. We compared Veterans with access to tele dermatology (TD) and those without (non-TD). We identified pathology-

confirmed primary melanomas in Veterans who had had at least one encounter at a VA facility during a 3-year study period. The age-adjusted melanoma incidence for all, TD and non-TD Veterans was 36, 15 and 57 per 100,000, respectively. The mean Breslow depth was significantly greater in the TD group (P = 0.03). Although a higher proportion of thin (Breslow depth ≤1 mm) TD melanomas were mitotically active, this difference was not significant. We also found that 180 (40%) of the non-TD (face-to-face) diagnosed melanomas were from Veterans living in areas where TD was available. This suggests that the higher melanoma incidence in the non-TD group was mainly due to under-utilization of TD services. The study demonstrated that the TD service was not fully utilized in the VISN20 region, although the reasons for this are not clear. Where TD was utilized it tended to diagnose more advanced melanomas with worse initial prognosis.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/24352898>

Kahn, E, MD; Sossong, S, MPH, FACHE; Goh, A, MD; Carpenter, D, MPH and Goldstein, S, MD. (2013). Evaluation of Skin Cancer in Northern California Kaiser Permanente's Store-and-Forward Teledermatology Referral Program. *Telemedicine Journal and E-Health*, 19(10), 780-785.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|------------------------|---------|---------|------|
| 7 months | CA | 293 | Store-and-Forward | Retrospective Analysis | x | x | x |

Summary

Objective: To determine whether teledermatology referrals yield a shorter time to biopsy of the most common types of skin cancer versus conventional dermatology referrals.

Subjects and Methods: A retrospective chart review was performed of California's Central Valley Kaiser Permanente conventional dermatology or teledermatology referrals that yielded a positive skin cancer biopsy over a 7-month period. Four primary care clinics at Kaiser Permanente's Stockton Medical Center in California's Central Valley were included. Patients who were studied were treated for

squamous cell carcinoma of skin, basal cell carcinoma of skin, and malignant melanoma. We compared the time interval between initial evaluation and biopsy of the most common types of skin cancer for teledermatology versus traditional referrals from primary care.

Results: Our study criteria were met by 293 patient cases (58% conventional referrals and 42% teledermatology referrals). The mean time to biopsy of skin cancer was 13.8 days for conventional referrals (median, 12.0 days) versus a mean of 9.7 days (median, 9.0 days) for teledermatology referrals ($p < 0.0001$).

Conclusions: The use of teledermatology in remote areas results in a shorter time to biopsy than traditional referral methods as a result of improved triaging measures.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/23889079>

Philp, J, MD; Frieden, I, MD and Cordoro, K, MD. (2013). Pediatric teledermatology consultations: relationship between provided data and diagnosis. *Pediatric Dermatology*, 30(5), 561-567.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|----------------------------|---------|---------|------|
| 1 year | CA | 395 | Store-and-Forward Images | Retrospective Cohort Study | x | x | |

Summary

There is a shortage of pediatric dermatologists. Teledermatology has emerged as a tool to facilitate access to dermatologists. Many questions remain regarding how to optimize consultations in order to provide the best diagnosis and management recommendations. The aim of this retrospective cohort study was to categorize the historical data and judge the adequacy of photographs sent by referring providers to our academic pediatric teledermatology practice at the University of California, San Francisco, and to evaluate the relationship of these data to our ability to render a diagnosis. A diagnosis was rendered in 75% of cases. The only historical data associated with receiving a diagnosis was prior treatment (OR 2.01, CI 1.01, 4, $p < 0.05$). Appropriate image distance from the target was

associated with receiving a diagnosis for rashes (OR 2.69, CI 1.07, 6.8, $p = 0.04$) and growths (OR 4.16, CI 1.04, 16.6, $p = 0.04$). A lack of diagnosis was significantly associated with a recommendation for referral for biopsy (OR 0.03, CI 0.01, 0.10, $p < 0.0001$) or for in-person consultation (OR 0.19, CI 0.05, 0.66, $p < 0.001$). In conclusion, pediatric teledermatologists are able to make a diagnosis most of the time, regardless of historical information provided or image quality. The rate of diagnosis may be improved with the use of standardized templates for historical information. Similarly, photography training could minimize the need for in-person consultation. Specific information regarding prior treatments could also help in providing useful management recommendations.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/23889079>

Lamel, S, MD; Chambers, C, MD, MPH; Ratnarathorn, MD; Armstrong, A, MD, MPH. (2012). Impact of Live Interactive Teledermatology on Diagnosis, Disease Management, and Clinical Outcomes. *Archives of Dermatology*, 148(1), 61-5.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|------------------------------------|------------------------|---------|---------|------|
| 2 years | CA | 1500 | Live interactive video dermatology | Retrospective Analysis | x | x | |

Summary

Objective: To assess the impact of live interactive teledermatology consultations on changes in diagnosis, disease management, and clinical outcomes.

Design: We conducted a retrospective analysis of 1500 patients evaluated via live interactive teledermatology between 2003 and 2005 at the University of California, Davis. We compared diagnoses and treatment plans between the referring physicians and the teledermatologists. Patients with 2 or more teledermatology visits within a 1-year period were assessed for changes in clinical outcomes.

Setting: Academic medical center with an established teledermatology program since 1996.

Participants: Medical records were evaluated for 1500 patients who underwent live interactive teledermatology consultation. Patients seen for more than 1 teledermatology visit were included in the clinical outcome assessment.

Intervention: Live interactive teledermatology consultation.

Main Outcome Measures: Changes in diagnosis, disease management, and clinical outcome.

Results: Compared with diagnoses and treatment plans from referring physicians, the 1500 live interactive teledermatology consultations resulted in changes in diagnosis in 69.9% of patients and changes in disease management in 97.7% of patients. Among 313 patients with at least 2 teledermatology visits within 1 year, clinical improvement was observed in 68.7% of patients. Multivariate analysis showed that changes in diagnosis ($P = .01$), changes in disease management ($P < .001$), and the number of teledermatology visits ($P < .001$) were significantly associated with improved clinical outcomes.

Conclusions: Live interactive teledermatology consultations result in changes in diagnosis and disease management in most consultations. The numbers of live interactive teledermatology visits and changes in diagnosis and disease management are significantly associated with improved clinical outcomes.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/22250233>

Whited, J, MD, MHS. (2010). Economic Analysis of Telemedicine and the Teledermatology Paradigm. *Telemedicine Journal and E-Health*, 16(2), 223-228.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|---|-------------|---|--|---------|---------|------|
| 2 years | NC (One study examined in the paper takes place in Spain) | 140 | Store-and-Forward and Real Time Interactive | Case Study Comparison of two Cost Effectiveness Analysis Studies | | | x |

Summary

Abstract Economic considerations are an important component in the planning and execution of a telemedicine program. The goal of this review is to familiarize readers with economic concepts relevant to the analysis of telemedicine programs. Economic perspectives, cost attribution, types of economic analysis, and commonly encountered problems will be discussed as they pertain to telemedicine. Societal perspectives, healthcare system perspectives, patient perspectives, fixed versus variable costs, labor costs, and distinctions between cost-effectiveness analyses and other types of economic analysis also will be examined. Examples from the teledermatology literature will be used as a paradigm to illustrate how these concepts are integrated into existing analyses of teledermatology systems. Teledermatology shows promise as a cost-saving healthcare delivery system with outcomes comparable to or better than those of conventional care processes. The literature also points out the importance of economic perspectives in the findings and interpretation of an analysis.

Access: <http://www.ncbi.nlm.nih.gov/pubmed/24632888>

Hsaio, JL., Oh, DH. (2008). The impact of store-and-forward teledermatology on skin cancer diagnosis and treatment. *Journal of the American Academy of Dermatology*, 59(2), 261-267.

| Study Length | State | Sample Size | Telehealth Modality Type | Method | Outcome | Quality | Cost |
|--------------|-------|-------------|--------------------------|---------------|---------|---------|------|
| 4.5 years | CA | 169 | Store-and-Forward | Retrospective | x | x | |

Summary

Background: Although the diagnostic accuracy of teledermatology has been extensively studied, the clinical outcomes associated with teledermatology are still unclear.

Objective: We examined the time intervals in which skin cancer patients referred conventionally or by store-and-forward teledermatology

were evaluated, diagnosed, and treated.

Methods: A chart review was performed of all patients who had been treated for skin cancer in a Veterans Affairs medical center's dermatologic surgery clinics as a result of a conventional dermatology or teledermatology referral from 3 remote primary care clinics over a 4.5 year period.

Results: One hundred sixty-nine patient cases met the study criteria (45.6% conventional referrals, 54.4% teledermatology referrals). For conventional and teledermatology referrals, respectively, the overall mean time intervals for initial consult completion were 48 and 4 days ($p < .0001$), for biopsy were 57 and 38 days ($p = .034$), and for surgery were 125 and 104 days ($p = .006$). Teledermatology consults were also associated with fewer dermatology clinic visits before surgery ($p = .02$).

Limitations: This was a retrospective study conducted on a Veterans Affairs healthcare system and a specific skin cancer patient population, which may not be directly comparable to other organizations.

Conclusion: Clinical outcomes in skin cancer management via teledermatology, as measured by times to diagnosis and to surgical treatment, can be comparable to, if not better than, management by conventional referrals for remotely located patients.

Access: <http://dx.doi.org/10.1016/j.jaad.2008.04.011>