



American Telemedicine Association
Connected to Care

Research Outcomes

Telemedicine's Impact on Healthcare Cost and Quality

April 2015

Over 40 years of research has yielded a wealth of data about the cost effectiveness and efficacy of many telemedicine applications. PubMed a bibliographic database of medical research that is maintained by the National Library of Medicine includes over 12,000 citations of published works related to telemedicine or telehealth. Over 2,000 evaluative studies related to telemedicine have been published in two journals devoted to telemedicine alone. The summaries that appear highlight the results from a few of the studies that have evaluated the cost effectiveness, quality of care and patient acceptance of telemedicine. In addition, leading, validated studies have been identified by many of the ATA Member Groups. These are summarized at the end of this paper.

COST EFFECTIVENESS OF TELEMEDICINE

Most of the peer-reviewed research about the cost effectiveness of telemedicine that is based on large sample sizes and follow sound scientific rigor are relatively new, many emerging in the past two years. These studies are consistent in finding that telemedicine saves the patients, providers and payers money when compared with traditional approaches to providing care. Many of these studies assess the cost effectiveness of specific telemedicine applications.

Results From A Patient-Centered Medical Home Pilot At UPMC Health Plan Hold Lessons For Broader Adoption Of The Model Cynthia Napier Rosenberg, Pamela Peele, Donna Keyser, Sandra McAnallen, and Diane Holder *Health Affairs November 2012 31:112423-2431; doi:10.1377/hlthaff.2011.1002*

The patient-centered medical home is a promising model for improving access to high-quality care for more Americans at lower cost. However, feasible pathways for achieving a transformation from current primary care practices to this new model have yet to be fully identified. We report on the experience of UPMC Health Plan—part of a large, integrated delivery and financing system headquartered in Pittsburgh, Pennsylvania—in its efforts to support primary care practices as they converted to patient-centered medical homes. From 2008 through 2010, sites participating in the UPMC pilot achieved lower medical and pharmacy costs; more efficient service delivery, such as lower hospital admissions and readmissions and less use of hospital emergency departments; and a 160 percent return on the plan's investment when compared with nonparticipating sites. We suggest approaches that could spur the adoption and spread of the model, including that payers be offered incentives to enter into patient-centered medical home contracts with interested providers; that payers increase efforts to provide primary care practices with access to usable data on their patient populations; and that telehealth be instituted to connect care managers to patients and practices when in-person visits are not possible or necessary.

Costs For 'Hospital At Home' Patients Were 19 Percent Lower, With Equal Or Better Outcomes Compared To Similar Inpatients Lesley Cryer, Scott B. Shannon, Melanie Van Amsterdam, and Bruce Leff *Health Affairs June 2012 31:61237-1243; doi:10.1377/hlthaff.2011.1132*

Hospitals are the standard acute care venues in the United States, but hospital care is expensive and can pose health

threats for older people. Albuquerque, New Mexico–based Presbyterian Healthcare Services adapted the Hospital at Home® model developed by the Johns Hopkins University Schools of Medicine and Public Health to provide acute hospital–level care within patients’ homes. Patients show comparable or better clinical outcomes compared with similar inpatients, and they show higher satisfaction levels. Available to Medicare Advantage and Medicaid patients with common acute care diagnoses, this program achieved savings of 19 percent over costs for similar inpatients. These savings were predominantly derived from lower average length-of-stay and use of fewer lab and diagnostic tests compared with similar patients in hospital acute care. Hospital at Home advances the Triple Aim of clinical quality, affordability, and exceptional patient experience.

Integrated Telehealth And Care Management Program For Medicare Beneficiaries With Chronic Disease Linked To Savings Laurence C. Baker, Scott J. Johnson, Dendy Macaulay, and Howard Birnbaum *Health Affairs September 2011 30:91689-1697; doi:10.1377/hlthaff.2011.0216*

Treatment of chronically ill people constitutes nearly four-fifths of US health care spending, but it is hampered by a fragmented delivery system and discontinuities of care. We examined the impact of a care coordination approach called the Health Buddy Program, which integrates a telehealth tool with care management for chronically ill Medicare beneficiaries. We evaluated the program’s impact on spending for patients of two clinics in the US Northwest who were exposed to the intervention, and we compared their experience with that of matched controls. We found significant savings among patients who used the Health Buddy telehealth program, which was associated with spending reductions of approximately 7.7–13.3 percent (\$312–\$542) per person per quarter. These results suggest that carefully designed and implemented care management and telehealth programs can help reduce health care spending and that such programs merit continued attention by Medicare. Meanwhile, mortality differences in the treatment and control groups suggest that the intervention may have produced noticeable changes in health outcomes, but we leave it to future research to explore these effects fully.

The Value of Provider-to-Provider Telehealth Technologies Center for Information Technology Leadership Partners HealthCare System, Inc, 2007

This study examined several specific telemedicine applications and used a rigorous approach to define both costs and financial benefits to the nationwide implementation of each application.

- For the use of telemedicine to join EMERGENCY ROOMS - the cost to equip all US emergency departments with hybrid telehealth technologies could easily be covered by savings from a reduction in transfers between emergency departments. From a baseline of 2.2 million patients transported each year between emergency departments at a cost of \$1.39 billion in transportation costs, hybrid technologies would avoid 850,000 transports with a cost savings of \$537 million a year.
- For the use of telemedicine in CORRECTIONAL FACILITIES - Correctional facilities could cover their costs of hybrid telehealth equipment by savings from a reduction in transporting patients to emergency departments and to physician offices, and by avoiding the costs of the emergency department visit. From a baseline of 94,180 transports made annually from correctional facilities to emergency departments at a cost of \$158 million in transportation and visit costs, hybrid technologies could avoid almost 40,000 transports with a cost savings of \$60.3 million a year. Further, hybrid technologies could avoid visits to physician offices. From an annual baseline of 691,000 physician office visits at a cost of \$302 million, hybrid technologies could avoid 543,000 inmate transports with a cost savings of \$210 million.
- For the use of telemedicine in NURSING HOMES - the costs of implementing hybrid telehealth equipment in nursing homes could be covered by savings from a reduction in transferring residents to emergency departments and physician offices, and by avoiding the costs of the emergency department visit. From a baseline of 2.7 million transports made annually from nursing facilities to emergency departments at a cost of \$3.62 billion in current transportation and emergency department visit costs, hybrid technologies could avoid 387,000 transports with a cost savings of \$327 million. In addition, of the 10.1 million physician office visits made annually from nursing facilities at a cost of \$1.29 billion for in-person physician office visits and transportation, hybrid technologies could avoid 6.87 million transports with a cost savings of \$479 million.

Care Coordination/Home Telehealth: The Systematic Implementation of Health Informatics, Home Telehealth, and Disease Management to Support the Care of Veteran Patients with Chronic Conditions Adam Darkins, Patricia Ryan, Rita Kobb, Linda Foster, Ellen Edmonson, Bonnie Wakefield, Anne E. Lancaster *Telemedicine and e-Health*. December 2008, 14(10): 1118-1126.

The Veterans Health Administration (VHA) introduced a national home telehealth program, Care Coordination/Home Telehealth (CCHT), in 2003 to coordinate the care of veteran patients with chronic conditions and avoid their unnecessary admission to long-term institutional care. CCHT patients increased from 2,000 to 31,570 (1,500% growth) between 2003 and 2007. CCHT is now a routine noninstitutional care (NIC) service provided by VHA to support veteran patients with chronic conditions as they age. Routine analysis of data obtained for quality and performance purposes from a cohort of 17,025 CCHT patients shows the benefits of a 25% reduction in numbers of bed days of care, 19% reduction in numbers of hospital admissions, and mean satisfaction score rating of 86% after enrollment into the program. These results demonstrate a dramatic reduction in costs and an equally dramatic increase in quality.

A Systematic Review of the Key Indicators for Assessing Telehomecare Cost-Effectiveness Stephanie Vergara Rojas, Marie-Pierre Gagnon. *Telemedicine and e-Health* November 1, 2008, 14(9): 896-904. doi:10.1089/tmj.2008.0009. This careful review identified reports on telehomecare published between 1997 and 2007. Of the identified studies, 23 were appropriate for comparison of costs in various ways. Of these, 70% were in the United States, 15 of 23 were randomized control trials, and 48% were published between 2003 and 2007. Teleconsultation was about equal to telemonitoring in the services. Total cost, cost per patient, and cost per visit were all reduced by telehomecare. The report also concluded that standardization of cost outcomes should be implemented in order to help funding agencies better understand the importance of telehomecare.

Economic Impact of eICU Implementation in an Academic Surgical ICU Benjamin A Kohl, Frank D Sites, Jacob T Gutsche, Patrick Kim, Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA *Crit Care Med*. 2007;35(12):A26.

This study shows an improvement in mortality and length of stay after implementing eICU (VISICU, Baltimore, MD) in a large academic surgical ICU. The purpose of this study was to measure the economic impact of this transition. Hypothesis: Implementation of eICU in an academic surgical ICU, allowing round-the clock intensivist oversight, will decrease ICU and hospital costs. METHODS: The study retrospectively compared a random sample of 189 patients pre-eICU to 2,622 patients 3 years post eICU using a multiplier of 13.87 to normalize populations. Assumptions based upon published literature include an average surgical ICU cost per day of \$1,500-\$2,000 and an average daily cost on a general floor of \$500-\$600. Because of the disparate sizes in populations a multiplier of 13.87 was used to standardize the numbers. There was no significant change in practice paradigm during the time period. APACHE III scores were used to calculate predicted length of stay in ICU and hospital. RESULTS: An almost 10% reduction in ICU stay and 20% reduction in floor stay occurred after implementation of eICU. This translated into a savings of \$706,272-\$941,697 for the ICU and \$2,134,339-\$2,842,940 for the floor. CONCLUSIONS: Implementation of an eICU in an academic SICU resulted in significantly reduced costs.

Cost-Utility Analysis of Telemedicine and Ophthalmoscopy for Retinopathy of Prematurity Management

Kevin M. Jackson, OD, MPH; Karen E. Scott, MD, MBA; Joshua Graff Zivin, PhD; David A. Bateman, MD; John T. Flynn, MD; Jeremy D. Keenan, MD, MPH; Michael F. Chiang, MD Arch Ophthalmol. 2008; 126(4):493-499.

Objective To evaluate the cost-effectiveness of telemedicine and standard ophthalmoscopy for retinopathy of prematurity (ROP) management. METHODS - Models were developed to represent ROP examination and treatment using telemedicine and standard ophthalmoscopy. Cost-utility analysis was performed using decision analysis, evidence-based outcome data from published literature, and present value modeling. Visual outcome

data were converted to patient preference–based time trade-off utility values based on published literature. Costs of disease management were determined based on 2006 Medicare reimbursements. Costs per quality-adjusted life year gained by telemedicine and ophthalmoscopy for ROP management were compared. One-way sensitivity analysis was performed on the following variables: discount rate (0%-7%), incidence of treatment-requiring ROP (1%-20%), sensitivity and specificity of ophthalmoscopic diagnosis (75%-100%), percentage of readable telemedicine images (75%-100%), and sensitivity and specificity of telemedicine diagnosis (75%-100%). **RESULTS** For infants with birth weight less than 1500 g using a 3% discount rate for costs and outcomes, the costs per quality-adjusted life year gained were \$3193 with telemedicine and \$5617 with standard ophthalmoscopy. Sensitivity analysis resulted in ranges of costs per quality-adjusted life year from \$1235 to \$18 898 for telemedicine and from \$2171 to \$27 215 for ophthalmoscopy. **CONCLUSIONS** Telemedicine is more cost-effective than standard ophthalmoscopy for ROP management. Both strategies are highly cost-effective compared with other health care interventions.

TELEMEDICINE AND QUALITY OF CARE

Scientific studies in this area indicate that the use of telemedicine for such applications as monitoring of chronic care patients or allowing specialists to provide care to patients over a large region care have resulted in significantly improved care. For most telemedicine applications, studies have shown that there is no difference in the ability of the provider to obtain clinical information, make an accurate diagnosis, and develop a treatment plan that produces the same desired clinical outcomes as compared to in-person care when used appropriately. Here are a few examples.

Peer Support For Self-Management Of Diabetes Improved Outcomes In International Settings Edwin B. Fisher, Renée I. Boothroyd, Muchieh Maggy Coufal, Linda C. Baumann, Jean Claude Mbanya, Mary Jane Rotheram-orus, Boosaba Sanguanpravit, and Chanuantong Tanasugarn *Health Affairs January 2012 31:1130-139*;
doi:10.1377/hlthaff.2011.0914

Self-management of diabetes is essential to reducing the risks of associated disabilities. But effective self-management is often short-lived. Peers can provide the kind of ongoing support that is needed for sustained self-management of diabetes. In this context, peers are nonprofessionals who have diabetes or close familiarity with its management. Key functions of effective peer support include assistance in daily management, social and emotional support, linkage to clinical care, and ongoing availability of support. Using these four functions as a template of peer support, project teams in Cameroon, South Africa, Thailand, and Uganda developed and then evaluated peer support interventions for adults with diabetes. Our initial assessment found improvements in symptom management, diet, blood pressure, body mass index, and blood sugar levels for many of those taking part in the programs. For policy makers, the broader message is that by emphasizing the four key peer support functions, diabetes management programs can be successfully introduced across varied cultural settings and within diverse health systems.

Indian Health Service Innovations Have Helped Reduce Health Disparities Affecting American Indian And Alaska Native People Thomas D. Sequist, Theresa Cullen, and Kelly J. Acton *Health Affairs October 2011 30:101965-1973*;
doi:10.1377/hlthaff.2011.0630

The Indian Health Service (IHS), a federal health system, cares for 2 million of the country's 5.2 million American Indian and Alaska Native people. This system has increasingly focused on innovative uses of health information technology and telemedicine, as well as comprehensive, locally tailored prevention and disease management programs, to promote health equity in a population facing multiple health disparities. Important recent achievements include a reduction in the life-expectancy gap between American Indian and Alaska Native people and whites (from eight years to five years) and improved measures of diabetes control (including 20 percent and 10 percent reductions in the levels of low-density lipoprotein cholesterol and hemoglobin A1c, respectively).

However, disparities persist between American Indian and Alaska Native people and the overall US population. Continued innovation and increased funding are required to further improve health and achieve equity.

Home-based telehealth: a review and meta analysis Dellifraire JL, Dansky KH. *J Telemed Telecare*. 2008;14(2):62-6
Department of Health Policy and Administration, The Pennsylvania State University, Pennsylvania 16802, USA. We conducted a systematic review to identify studies on the effect of home telehealth on clinical care outcomes. The search was restricted to peer-reviewed publications (published between 2001 and 2007) about studies conducted in home or residential settings. The search yielded 154 potential articles and dissertations. A total of 29 articles met the inclusion criteria and were included in a meta-analysis. The weighted mean effect size for the overall meta-analysis was 0.50, and the z-statistic was 3.0, indicating that telehealth had a moderate, positive and significant effect ($P < \text{or} = 0.01$) on clinical outcomes. Sub-analyses also indicated positive significant effects of telehealth for some disease categories (heart disease and psychiatric conditions), but not others (diabetes), patient populations and telehealth interventions. Overall, the meta-analysis indicated that telehealth positively affects clinical outcomes of care, even in different patient populations.

Janca, 2000. Telepsychiatry: an update on technology and its implications. *Curr Op in Psych* 13: 591-7.

This study/article concluded that even “early research demonstrated that the psychiatric interview conducted over videoconferencing is reliable for diagnostic assessment and treatment recommendations.” In addition, a retrospective review of medical records comparing clinical outcomes of patients seen by [interactive TV] (IATV) and those in-person showed no significant difference found in the percentage of change in Global Assessment of Functioning (GAF) between the two groups suggesting clinical outcomes were not affected by the use of IATV.

Young TL, Ireson C. Effectiveness of school-based telehealth care in urban and rural elementary schools. *Pediatrics*. 2003 Nov;112(5):1088-94. Telehealth technology was effective in delivering pediatric acute care to children in [these] schools. Pediatric providers, nurses, parents, and children reported primary care school-based telehealth as an acceptable alternative to traditional health care delivery systems.

Leggett PF, Graham L, Steele K, Gilliland A, Stevenson M, O'Reilly D, Wootton R, and Taggart A (Sep 2001)
Telerheumatology: Diagnostic accuracy and acceptability to patient, specialist, and general practitioner. *British Journal of General Practice* 51(470) : 746-8.

This study examines the diagnostic accuracy and acceptability of telemedicine in the field of rheumatology. One hundred patients had a telephone and televisual consultation and the results were compared with a face-to-face consultation. While the telephone consultations were often unsatisfactory, the televisual consultations were highly accurate (97%) and acceptable to patients, general practitioners, and specialists.

Jerant AF, Azari R, Martinez C, Nesbitt TS. A randomized trial of telenursing to reduce hospitalization for heart failure: patient-centered outcomes and nursing indicators. *Home Health Care Serv Q*. 2003;22(1):1-20. Patient self-care adherence, medications, health status, and satisfaction did not significantly differ between groups. Telenursing can reduce CHF hospitalizations and allow increased frequency of communication with patients.

Belmont JM, Mattioli LF. Accuracy of analog telephonic stethoscopy for pediatric telecardiology. *Pediatrics*. 2003 Oct;112(4):780-6 In pediatric patients, a narrow-bandwidth telephonic stethoscope can accurately distinguish between functional and organic murmurs and thus can detect heart disease. Accuracy is greatest when the instrument is used by an experienced examiner with patients at least 5 years of age.

Ermer D.J., 1999. Child and adolescent telepsychiatry clinics. *Psych Services* Jul 29(7): 409-14. This study concluded that severely disturbed children can be adequately assessed and treated, the range of expressed emotion and the quality of clinical interaction appear similar in TelePsychiatry and [in-person] interactions, and children in crisis can be safely assessed and treated [via telepsychiatry].

Arizona telepsychiatry project gains national attention, patient approval, 1998. *Mental Health Weekly*, Jan 19, 8(3): 4.

Main purpose of the project was to facilitate mental health in the region with the use of telehealth technology – role of simplifying case management and prior authorization. Program instituted by the Northern Arizona Regional Behavioral Health Authority.

Craig J, et. al. 2000. The cost-effectiveness of teleneurology consultations for patients admitted to hospitals without neurologists on site. *Journ of Telemedicine and Telecare* 6 (suppl 1): S1: 46-9.

Comparison of outcomes of patients admitted to two small. One hospital received neurological services by telehealth, the other in-person. Neurological services were provided via Telemedicine. Comparing case-mix, process of management, and outcomes for all patients using ICD-10 codes with a final diagnosis of neurological condition there were no appreciable differences noted between the clinical outcomes and the length of stay between patients receiving services in-person and those who received services via telehealth.

Telemedicine and Diabetes Dimmick et. al. *Telemed Journal and e-Health*, 9(1): 13-23 (2003)

This is a study of patients receiving care over a telemedicine network that linked three hospitals and an FQHC with six sites, a dental clinic, and patient homes. Outcomes from the disease management programs conducted over telemedicine for the diabetes group showed that the diabetes disease management program increased the number of diabetics who brought their blood sugar under control.

PATIENT SATISFACTION WITH TELEMEDICINE

Patient satisfaction with the use of telemedicine to access care and the use of telecommunications technologies to connect with specialists and other health care providers in order to meet unmet medical needs has consistently been very high. Degrees of satisfaction may vary slightly with the specialty accessed through telemedicine, but overall patients have responded well to its use. The source of satisfaction for most patients is the ability to see a specialist trained in the area most closely related to the patient's condition, the feeling of getting personalized care from a provider who has the patient's interest in mind, and the ability to communicate with the provider in a very personal and intimate manner over the telecommunications technologies. Examples appear below.

Gustke, S.S., Balch, D.C., West, V.L., and Rogers, L.O. 2000. Patient satisfaction with telemedicine. *Telemedicine Journal* Spring 6(1): 5-13.

Patient satisfaction was examined in relation to patient age, gender, race, income, education, and insurance. Overall patient satisfaction was found to be 98.3%.

Janca, 2000. Telepsychiatry: an update on technology and its implications. *Curr Op in Psych* 13: 591-7.

In this study, results indicated that “most consumers found that a video link with a psychiatrist moderately or greatly helped them in managing their treatment, with 98% of the preferring to be offered videoconferencing in combination with local services.”

Brodey et al, 2000. Satisfaction of forensic psychiatry patients with remote telepsychiatric evaluation. *Psych Services*: Oct 51(10): 1305-7.

This study indicated that satisfaction did not differ significantly between video and in-person consultations for incarcerated patients.

CONTRIBUTIONS FROM ATA MEMBER GROUPS

ATA Member Groups were asked to identify some of the best research studies in their area of interest. The following are their contributions.

OCULAR TELEHEALTH SIG

Cost efficiency study for a specific Teleophthalmology-DR program:

Whited JD, Datta SK, Aiello LM, Aiello LP, Cavallerano JD, Conlin PR, Horton MB, Vigersky RA, Poropatich RK, Challa P, Darkins AW, Bursell SE. A modeled economic analysis of a digital teleophthalmology system as used by three federal healthcare agencies for detecting proliferative diabetic retinopathy. *Telemedicine and e-Health*, 2005;11:641-651.

TELEICU SIG

The Research Agenda in ICU Telemedicine

A Statement From the Critical Care Societies Collaborative

Jeremy M. Kahn, MD, Nicholas S. Hill, MD, FCCP, Craig M. Lilly, MD, FCCP, Derek C. Angus, MD, MPH, FCCP, Judith Jacobi, PharmD, Gordon D. Rubenfeld, MD, Jeffrey M. Rothschild, MD, MPH, Anne E. Sales, RN, PhD, Damon C. Scales, MD, PhD and James A. L. Mathers, MD, FCCP

Impact of Telemedicine Intensive Care Unit Coverage on Patient Outcomes

A Systematic Review and Meta-analysis

Lance Brendan Young, PhD, MBA; Paul S. Chan, MD, MSc; Xin Lu, MS; Brahmajee K. Nallamothu, MD, MPH; Comilla Sasson, MD, MS; Peter M. Cram, MD, MBA

A Working Lexicon for the Tele-Intensive Care Unit: We Need to Define Tele-Intensive Care Unit to Grow and Understand It

H. Neal Reynolds, M.D.,¹ Herb Rogove, D.O.,² Joseph Bander, M.D.,³ Matt McCambridge, M.D.,⁴ Elizabeth Cowboy, M.D.,⁵ and Michael Niemeier, M.D.⁶, 1R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Baltimore, Maryland.

2C3O Medical Group, Ojai, California. 3St. Joseph Mercy Health System, Ann Arbor, Michigan.

4Lehigh Valley Health Network, Allentown, Pennsylvania. 5Advanced ICU Care, St. Louis, Missouri. 6Methodist Hospital, Clarian Health, Indianapolis, Indiana.

Hospital Mortality, Length of Stay, and Preventable Complications Among Critically Ill Patients Before and After Tele-ICU Reengineering of Critical Care Processes

Craig M. Lilly, MD, Shawn Cody, MSN/MBA, RN, Huifang Zhao, PhD, Karen Landry, Stephen P. Baker, MScPH, John McIlwaine, DO, M. Willis Chandler, MBA, Richard S. Irwin, MD, for the University of Massachusetts Memorial Critical Care Operations Group

Telemedicine in the Intensive Care Unit

Developed and Written by the SCCM Tele-ICU Committee

TELEDERMATOLOGY SIG

Pak H, Triplett CA, Lindquist JH, Grambow SC, Whited JD. Store-and-forward teledermatology results in similar clinical outcomes to conventional clinic-based care. *J Telemed Telecare*. 2007;13(1):26-30. PubMed PMID: 17288655. A randomized, prospective study in the DoD population and its beneficiaries showing equivalent outcomes, as assessed by clinical appearance before and 4 months following conventional and asynchronous teledermatology.

Hsiao JL, Oh DH. The impact of store-and-forward teledermatology on skin cancer diagnosis and treatment. *J Am Acad Dermatol*. 2008 Aug;59(2):260-7. Epub 2008 May 15. PubMed PMID: 18485526. A retrospective study showing that VA patients with skin cancer who were initially managed by asynchronous teledermatology were diagnosed, biopsied and reached definitive treatment earlier than conventional care and required fewer clinic visits.

Lamel S, Chambers CJ, Ratnarathorn M, Armstrong AW. Impact of live interactive teledermatology on diagnosis, disease management, and clinical outcomes. *Arch Dermatol*. 2012 Jan;148(1):61-5. PubMed PMID: 22250233.3). A retrospective analysis showing that live interactive teledermatology altered patients' diagnosis and management relative to the referring providers' in the majority of cases, and were associated with improved clinical outcomes.

Whited JD. Economic analysis of telemedicine and the teledermatology paradigm. *Telemed J E Health*. 2010 Mar;16(2):223-8. A review of several studies showing some cost-savings associated with teledermatology.

Warshaw EM, Hillman YJ, Greer NL, Hagel EM, MacDonald R, Rutks IR, Wilt TJ. Teledermatology for diagnosis and management of skin conditions: a systematic review. *J Am Acad Dermatol*. 2011 Apr;64(4):759-72. Epub 2010 Oct 30. Review. PubMed PMID: 21036419. This is not a meta-analysis, but is the most comprehensive recent synthesis of both asynchronous and live interactive teledermatology studies from 1990-2009. Overall, teledermatology and conventional care were comparable for diagnosis, management and patient satisfaction, though the authors caution about the use of teledermatology in cutaneous malignancies.

Edison KE, Ward DS, Dyer JA, Lane W, Chance L, Hicks LL. Diagnosis, diagnostic confidence, and management concordance in live-interactive and store-and-forward teledermatology compared to in-person examination. *Telemed J E Health*. 2008 Nov;14(9):889-95. PubMed PMID: 19035797. While confidence was lower for teledermatology modalities relative to in-person visits, the diagnostic and management concordance were high.

Armstrong AW, Wu J, Kovarik CL, Goldyne ME, Oh DH, McKoy KC, Shippy AM, Pak HS. State of teledermatology programs in the United States. *J Am Acad Dermatol*. 2012 Nov;67(5):939-44. doi: 10.1016/j.jaad.2012.02.019. Epub 2012 Mar 28. PubMed PMID: 22459360. While not a patient outcome study, this study documents the distribution of practice setting and payers for teledermatology in the U.S., and the rate of turnover of teledermatology programs over a 8 year period.

Armstrong AW, Johnson MA, Lin S, Maverakis E, Fazel N, Liu FT. Patient-Centered, Direct-Access Online Care for Management of Atopic Dermatitis: A Randomized Clinical Trial. *JAMA Dermatol*. 2014 Oct 22. doi: 10.1001/jamadermatol.2014.2299. [Epub ahead of print] PubMed PMID: 25338198.

Whited JD, Warshaw EM, Kapur K, Edison KE, Thottapurathu L, Raju S, Cook B, Engasser H, Pullen S, Moritz TE, Datta SK, Marty L, Foman NA, Suwattee P, Ward DS, Reda DJ. "Clinical course outcomes for store and forward teledermatology versus conventional consultation: a randomized trial." *J Telemed Telecare*. 2013 Jun;19(4):197-204. doi: 10.1177/1357633X13487116. Epub 2013 May 23. PubMed PMID: 23666440.

TELEMENTAL HEALTH SIG

Woolderink M, Smit F, van der Zanden R, Beecham J, Knapp M, Paulus A, et al. Design of an internet-based health economic evaluation of a preventive group-intervention for children of parents with mental illness or substance use disorders. *BMC Public Health*. 2010;10:470.

Shore JH, Brooks E, Savin DM, Manson SM, Libby AM. An economic evaluation of telehealth data collection with rural populations. *Psychiatr Serv*. 2007;58(6):830-5.

Fortney JC, Maciejewski ML, Tripathi SP, Deen TL, Pyne JM. A budget impact analysis of telemedicine-based collaborative care for depression. *Medical care*. 2011;49(9):872-80.

Ruskin PE, Silver-Aylaian M, Kling MA, Reed SA, Bradham DD, Hebel JR, et al. Treatment outcomes in depression: comparison of remote treatment through telepsychiatry to in-person treatment. *The American journal of psychiatry*. 2004;161(8):1471-6.

Rabinowitz T, Murphy KM, Amour JL, Ricci MA, Caputo MP, Newhouse PA. Benefits of a telepsychiatry consultation service for rural nursing home residents. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2010;16(1):34-40.

Myers KM, Valentine JM, Melzer SM. Feasibility, acceptability, and sustainability of telepsychiatry for children and adolescents. *Psychiatr Serv*. 2007;58(11):1493-6.

O'Reilly R, Bishop J, Maddox K, Hutchinson L, Fisman M, Takhar J. Is telepsychiatry equivalent to face-to-face psychiatry? Results from a randomized controlled equivalence trial. *Psychiatr Serv*. 2007;58(6):836-43.

Kessler D, Lewis G, Kaur S, Wiles N, King M, Weich S, et al. Therapist-delivered Internet psychotherapy for depression in primary care: a randomised controlled trial. *Lancet*. 2009;374(9690):628-34.

Fortney JC, Pyne JM, Edlund MJ, Williams DK, Robinson DE, Mittal D, et al. A randomized trial of telemedicine-based collaborative care for depression. *J Gen Intern Med*. 2007;22(8):1086-93.

TELEREHABILITATION SIG

Crowell, E., Givens, G., Jones, G., Brechtelsbauer, P., and Yao, J. (2011) Audiology Telepractice in a Clinical Environment: A Communication Perspective, *Journal of Otology, Rhinology and Laryngology*, 120 (7), 441-447.

HUMAN FACTORS SIG

Jennett, P.A., et al., *The socio-economic impact of telehealth: a systematic review*. *J Telemed Telecare*, 2003. 9(6): p. 311-20.

Bulik, R.J., *Human factors in primary care telemedicine encounters*. *J Telemed Telecare*, 2008. 14(4): p. 169-72.

C.K. and B.T. Karsh, *A systematic review of patient acceptance of consumer health information technology*. *Am Med Inform Assoc*, 2009. 16(4): p. 550-60.

C.K., et al., *Human factors and ergonomics in home care: Current concerns and future considerations for health information technology*. *Work*, 2009. 33(2): p. 201-9.

Kang, H.G., et al., *In situ monitoring of health in older adults: technologies and issues*. J Am Geriatr Soc, 2010. 58(8): p. 1579-86.

Wade, V.A., et al., *A systematic review of economic analyses of telehealth services using real time video communication*. BMC Health Serv Res, 2010. 10: p. 233.

Röing, Marta, and Inger K. Holmström. "Malpractice Claims in Swedish Telenursing: Lessons Learned From Interviews With Telenurses and Managers." *Nursing Research* 64.1 (2015): 35-43.

Lassfolk, C., et al. "Harvesting Features of an Affordable Cognitive Gym for Seniors." 16th Nordic Baltic Conference on Biomedical Engineering. Springer International Publishing, 2015.

Catchpole, Ken, et al. "A human factors subsystems approach to trauma care." *JAMA surgery* 149.9 (2014): 962-968.

Charness et al. "Metrics for assessing the reliability of a telemedicine remote monitoring system." *TMEH* 2013;19:487-492.

Morrison et al. "What design features are used in effective e-health interventions? A review using techniques from critical interpretative synthesis." *TMEH* 2012;18:137-144

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HOME TELEHEALTH & REMOTE MONITORING SIG

Care Coordination/Home Telehealth: The Systematic Implementation of Health Informatics, Home Telehealth, and Disease Management to Support the Care of Veteran Patients with Chronic Conditions

Adam Darkins, M.D., Patricia Ryan, R.N., M.S., Rita Kobb, M.N., A.P.R.N., Linda Foster, M.S.N., R.N., Ellen Edmonson, R.N., M.P.H., Bonnie Wakefield, Ph.D., R.N., and Anne E. Lancaster, B.Sc. Department of Veterans Affairs, Office of Care Coordination Services, Washington, D.C.

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PEDIATRIC TELEHEALTH SIG

McConnochie K, Wood N, Kitzman H, Herendeen N, Roy J, Roghmann K, Telemedicine Reduces Absence Resulting From Illness in Urban Child Care: Evaluation of an Innovation, *Pediatrics*, 2005; 115:1273-1282 Early study showing a 63% reduction in absence from child care due to illness when a pediatric telemedicine service is introduced during the daytime at 3 urban child care centers.

McConnochie KM, Tan J, Wood NE, Herendeen NE, Kitzman HJ, Roy J, Roghmann KJ. Acute illness utilization patterns before and after telemedicine in childcare for inner-city children: a cohort study. *Telemedicine journal and e-health* 2007; 13(4):381-90. This article is for those health care analysts who like statistical analysis and the ability to project financial impact given best case/worst case scenarios. Telemedicine saves money by replacing ED visits with less costly telemed office visits even if utilization goes up. “To estimate the most likely impact on “cost” one would use the most likely estimate for impact on overall utilization of 1.26 more visits per child. With this scenario, to break even with Rochester-area reimbursement rates would require replacement of 0.19 ED visits per year per child.”

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A larger study tracking the utilization patterns of urban and suburban children with telemedicine access in their school or child care center compared to a well matched control group without telemedicine access. “The mean age at utilization was 6.71 years, with 79% of all child-months being covered by Medicaid managed care. The overall utilization rate was 305.1 visits per 100 child-years. In multivariate analyses with adjustment for potential confounders, overall illness-related utilization rates (in-person or telemedicine visits per 100 child-years) for all sites were 23.5% greater for children with telemedicine access than for control children, but ED utilization was 22.2% less.” This is our Win Win Win article: you can overcome disparities in access to pediatric care for poor urban children, increase utilization for inner city kids to equal their suburban counterparts and save money by offsetting expensive ED visits for non-emergent conditions.

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