

L'évaluation médico-économique de la télémédecine

Bibliographie thématique

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Problématique

La télémedecine a permis depuis le début des années 1990 le suivi des femmes enceintes isolées, l'appui de spécialistes aux médecins généralistes, ainsi que l'amélioration du suivi des patients hypertendus et des dialysés. La loi relative à l'assurance maladie du 13 août 2004 la mentionne comme un acte à distance. En 2009, la loi portant réforme de l'hôpital et relative aux patients, à la santé et aux territoires (loi HPST) définit le mot télémedecine comme « une forme de pratique médicale à distance utilisant les technologies de l'information et de la communication » et le décret n° 2010-1229 du 19 octobre 2010 introduit les termes suivants :

- Téléconsultation : un médecin donne une consultation à distance (via des outils sécurisés) ;
- Télé-expertise : un médecin sollicite à distance l'avis d'un ou de plusieurs confrères ;
- Télésurveillance médicale : un médecin surveille à distance les paramètres médicaux d'un patient ;
- Télé-assistance médicale : un médecin assiste à distance un autre professionnel de santé au cours de la réalisation d'un acte ;
- Régulation médicale : réponse médicale apportée dans le cadre de l'activité des centres 15.

Depuis la loi de financement de la sécurité sociale pour 2014, des expérimentations de la télémedecine ont été lancées dans différentes régions dans le cadre du programme ETAPES (Expérimentations de Télémedecine pour l'Amélioration des Parcours En Santé). L'année 2018 marque un pas nouveau avec le basculement dans un financement de droit commun des actes de téléconsultation (TLC) et de télé-expertise (TLE) par accord conventionnel entre l'Assurance Maladie et les syndicats de médecins. La téléconsultation s'inscrit dans le respect du parcours de soins coordonné, le patient doit être connu du médecin depuis 12 mois et donner son consentement à la TLC. La TLE quant à elle est réservée jusqu'à fin 2020, aux patients pour lesquels l'accès aux soins doit être facilité au regard de leur état de santé ou de leur situation géographique. Enfin, le projet de loi d'organisation et de transformation du système de santé 2019 prévoit d'étendre le télésoin à d'autres professions de santé : pharmaciens d'officine, auxiliaires médicaux. En mars 2019, la Caisse nationale d'assurance maladie (Cnam) a établi un premier bilan à six mois des téléconsultations¹.

La télémedecine regroupant donc plusieurs formes d'organisation de la pratique médicale à distance, elle peut constituer un vecteur important d'amélioration de la qualité et de l'efficacité de la prise en charge du patient dans le cadre du parcours de soins. L'objectif de cette bibliographie est de recenser la littérature scientifique portant sur les études d'évaluation économique et clinique de la télémedecine et plus particulièrement de la télésurveillance avec un focus sur la télésurveillance pour insuffisance cardiaque. Les recherches bibliographiques ont été effectuées sur les bases de données et portails suivants : Irdes, BDSP, Medline et Science direct sur la période allant de 2010 à juin 2019 avec quelques références clés antérieures. Les revues de littérature (scoping review, literature review et systematic review) ont été privilégiées. Les références sont accompagnées de résumés et classées par ordre alphabétique d'auteurs. Cette bibliographie ne prétend pas à l'exhaustivité.

¹ [Communiqué de presse de la Cnam, 26 mars 2019](#)

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<https://www.irdes.fr/documentation/syntheses/l-evaluation-medico-economique-de-le-telemedecine.pdf>

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Les mots clefs interrogés sont les suivants :

Télémédecine

Telemedecine, tele medecine, telecare, tele care, telehealth, tele health, telehealthcare, telehomecare, tele homecare, tele home care, teleconsultation, tele consultation, e-medecine, emedecine, e-health, ehealth, epatient, videoconference(s), video conference(s), videoconsultation(s), video consultation(s), videoconsulting, remote diagnostic, remote diagnosis, remote diagnoses, remote evaluation, remote assessment, remote supervision, remote management, telepathology, tele pathology, teleradiology, tele radiology, telesurgery, tele surgery, telepsychiatry, tele psychiatry, telemental health, tele mental health, teledermatology, tele dermatology, teleaudiology, telemonitoring, tele monitoring, tele imaging, teleimaging, telecardiology, tele cardiology, telestroke, tele stroke, teleoncology, tele oncology, teleassistance, tele assistance

Évaluation

Economics, costs and cost analysis, cost(s), efficiencies, efficiency, healthcare evaluation mechanisms, outcome and process assessment, treatment assessment, patient satisfaction, program evaluation, technology assessment biomedical

Insuffisance cardiaque

Heart failure

Les dates clefs de la télémédecine en France

Loi n° 2004-810 relative à l'assurance maladie du 13 août 2004 : la télémédecine est définie comme un acte à distance dans l'article 32.

Loi Hôpital Patients Santé et Territoire (HPST) n° 2009-879 du 21 juillet 2009 : la télémédecine est définie comme une pratique médicale à distance faisant intervenir au moins un médecin.

Décret n° 2010-1229 du 19 octobre 2010 : il précise sa définition et sa mise en œuvre. Cinq types d'actes sont mentionnés : la téléconsultation, la télé-expertise, la télésurveillance médicale, la télé-assistance médicale et la réponse médicale apportée dans le cadre de la régulation médicale des urgences et de la permanence de soins.

Loi n° 2013-1203 de financement de la sécurité sociale pour 2014 du 23 décembre 2013 prévoit la mise en place d'expérimentations de financement dérogatoire de la télémédecine (téléconsultation, télé-expertise et télésurveillance) dans neuf régions (Article 36).

Loi n° 2016-1827 du 23 décembre 2016 de financement de la sécurité sociale pour 2017: elle proroge d'un an le financement des expérimentations et acte leur élargissement à l'ensemble du territoire.

Loi n° 2017-1836 du 30 décembre 2017 de financement de la sécurité sociale pour 2018 : l'article 54 bascule le financement de la télémédecine dans le droit commun de la sécurité sociale (tarification conventionnelle).

Avenant n° 6 à la convention nationale des médecins du 14 juin 2018 : il fixe les modalités de mise en œuvre et de tarification de la télémédecine (actes de téléconsultation et de télé-expertise).

Décret n° 2018-788 du 13 septembre 2018 : il fixe les modalités de la mise en œuvre des activités de la télémédecine et poursuit les expérimentations dans le domaine de la télésurveillance.

Arrêté du 27 octobre 2018 : il proroge pour quatre ans les expérimentations de télésurveillance pour cinq pathologies (diabète, prothèse cardiaque implantable, insuffisance rénale, cardiaque ou respiratoire chroniques).

Arrêté du 14 juin 2019 relatif à l'expérimentation pour la prise en charge par la télésurveillance du diabète gestationnel.

Loi n° 2019-774 du 24 juillet 2019 relative à l'organisation et à la transformation du système de santé : l'article 53 définit le télé soin comme pratique de soin à distance utilisant les technologies de l'information et de la communication qui met en rapport un ou plusieurs pharmaciens ou auxiliaires médicaux en complément de la télémédecine réservée aux professions médicales.

L'évaluation de la télémédecine

LES ETUDES D'ÉVALUATION ÉCONOMIQUE : REVUES DE LITTÉRATURE

Les études françaises d'évaluation médico-économique

Trois études d'évaluation médico-économique de la télémédecine ont été réalisées en France depuis le début des années 2000². La dernière publiée en 2013 a été menée par la Haute Autorité de santé (HAS) à la demande de la Direction générale de l'offre de soins (DGOS). Cette revue de la littérature internationale portait sur la période 2000-2013 avec un double objectif : réaliser un état des lieux des connaissances sur l'évaluation médico-économique de la télémédecine et apprécier l'apport de la littérature pour alimenter les réflexions concernant la question de l'efficacité de cette forme de pratique médicale, la définition d'axes de déploiement et l'identification de modèles de financement ; proposer un cadre d'évaluation afin de favoriser le développement d'études relatives à l'évaluation médico-économique de la télémédecine dans le contexte français. Si cette revue de la littérature, sans délimitation du champ à un domaine d'application spécifique, a pu montrer l'importance de la littérature économique dans les pays étrangers, elle a aussi mis en évidence deux principales limites : la forte hétérogénéité des études (sur le plan méthodologique et concernant les projets de télémédecine évalués) ainsi que la faiblesse de leur qualité méthodologique.

Afin que la nouvelle revue de littérature d'évaluation de la télémédecine commandée à la HAS pour la période 2014-2019 évite ces écueils, le périmètre de la télémédecine a été délimité à la télésurveillance, permettant *a priori* de limiter la diversité des formes d'organisation par télémédecine évaluées dans les études. Par ailleurs, l'amélioration de la qualité méthodologique des évaluations qui se dessinait déjà à partir de 2012 semble se confirmer, ce qui règle donc la faiblesse méthodologique. Cette revue de littérature est actuellement en cours à la HAS pour identifier les études d'évaluation médico-économiques en Europe et dans les autres pays. Le rapport final d'évaluation devrait paraître en septembre 2019 selon la feuille de route de la HAS³.

Akiyama, M. et Yoo, B. K. (2016). "A Systematic Review of the Economic Evaluation of Telemedicine in Japan." J Prev Med Public Health **49**(4): 183-196.

OBJECTIVES: There is no systematic review on economic evaluations of telemedicine in Japan, despite over 1000 trials implemented. Our systematic review aims to examine whether Japan's telemedicine is cost-saving or cost-effective, examine the methodological rigor of the economic evaluations, and discuss future studies needed to improve telemedicine's financial sustainability. **METHODS:** We searched five databases, including two Japanese databases, to find peer-reviewed articles published between January 1, 2000 and December 31, 2014 in English and Japanese that performed economic evaluations of Japan's

² HAS (2011). Efficacité de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS.

HAS (2013). Efficacité de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS.

Midy, F. (1998). La télémédecine : document de travail. Rapport Credes.

Midy, F., D. Polton, A. Strauss, J. Kletz, J. C. Moisson and C. Kornblum (2000). Télémédecine & évaluation. Aide méthodologique à l'évaluation de la télémédecine. Rapport Credes.

³ HAS (2019). Feuille de route « Évaluation de la télésurveillance pour éclairer la décision publique : quels sont les choix efficaces au regard de l'analyse de la littérature ?

telemedicine programs. The methodological rigorousness of the economic analyses was assessed with a well-established checklist. We calculated the benefit-to-cost ratio (BCR) when a reviewed study reported related data but did not report the BCR. All cost values were adjusted to 2014 US dollars. RESULTS: Among the 17 articles identified, six studies reported on settings connecting physicians for specialist consultations, and eleven studies on settings connecting healthcare providers and patients at home. There are three cost-benefit analyses and three cost-minimization analyses. The remaining studies measured the benefit of telemedicine only, using medical expenditure saved or users' willingness-to-pay. There was substantial diversity in the methodological rigorousness. Studies on teledermatology and teleradiology indicated a favorable level of economic efficiency. Studies on telehomecare gave mixed results. One cost-benefit analysis on telehomecare indicated a low economic efficiency, partly due to public subsidy rules, e.g., a too short budget period. CONCLUSIONS: Overall, telemedicine programs in Japan were indicated to have a favorable level of economic efficiency. However, the scarcity of the economic literature indicates the need for further rigorous economic evaluation studies.

Bergmo, T. S. (2010). "Economic evaluation in telemedicine - still room for improvement." J Telemed Telecare **16**(5): 229-231.

It has been reported that economic evaluations of telemedicine are less adherent to methodological standards than economic evaluations in other fields. Systematic reviews also show that most studies evaluate benefits in terms of the cost savings, with no assessment of the health benefits for patients. In a recent review of economic evaluations, I found 33 articles that measured both costs and non-resource consequences of using telemedicine in direct patient care. This represents a considerable increase compared to previous reviews. The articles analysed were highly diverse in both study context and applied methods. Most studies used multiple outcome measures, such as diagnostic accuracy, blood glucose levels, wound size or quality-adjusted life-years gained. The effectiveness measures appeared more consistent and well reported than the costings. Objectives, study design and choice of comparators were mostly well reported. However, most studies lacked information on perspective and costing method, few used general statistics and sensitivity analysis to assess validity, and even fewer used marginal analysis. These shortcomings in economic evaluation methodology are relatively common and have been found in other fields of research.

Bradford, N. K., Armfield, N. R., Young, J., et al. (2014). "Paediatric palliative care by video consultation at home: a cost minimisation analysis." BMC Health Serv Res **14**: 328.

BACKGROUND: In the vast state of Queensland, Australia, access to specialist paediatric services are only available in the capital city of Brisbane, and are limited in regional and remote locations. During home-based palliative care, it is not always desirable or practical to move a patient to attend appointments, and so access to care may be even further limited. To address these problems, at the Royal Children's Hospital (RCH) in Brisbane, a Home Telehealth Program (HTP) has been successfully established to provide palliative care consultations to families throughout Queensland. METHODS: A cost minimisation analysis was undertaken to compare the actual costs of the HTP consultations, with the estimated potential costs associated with face-to face-consultations occurring by either i) hospital based consultations in the outpatients department at the RCH, or ii) home visits from the Paediatric Palliative Care Service. The analysis was undertaken from the perspective of the Children's Health Service. The analysis was based on data from 95 home video consultations which occurred over a two year period, and included costs associated with projected: clinician time and travel; costs reimbursed to families for travel through the Patients Travel Subsidy (PTS) scheme; hospital outpatient clinic costs, project co-ordination and equipment

and infrastructure costs. The mean costs per consultation were calculated for each approach. RESULTS: Air travel (n = 24) significantly affected the results. The mean cost of the HTP intervention was \$294 and required no travel. The estimated mean cost per consultation in the hospital outpatient department was \$748. The mean cost of home visits per consultation was \$1214. Video consultation in the home is the most economical method of providing a consultation. The largest costs avoided to the health service are those associated with clinician time required for travel and the PTS scheme. CONCLUSION: While face-to-face consultations are the gold standard of care, for families located at a distance from the hospital, video consultation in the home presents an effective and cost efficient method to deliver a consultation. Additionally video consultation in the home ensures equity of access to services and minimum disruption to hospital based palliative care teams.

Caffery, L. J., Taylor, M., Gole, G., et al. (2019). "Models of care in tele-ophthalmology: A scoping review." *J Telemed Telecare* **25**(2): 106-122.

The objective of this review was to identify and describe telehealth models of care for ophthalmic services. We conducted a scoping review of the literature to identify how ophthalmic care can be delivered by telehealth. We searched the PubMed database to identify relevant articles which were screened based on pre-defined inclusion criteria. For included articles, data were extracted, categorised and analysed. Synthesis of findings was performed narratively. The scoping review included 78 articles describing 62 discrete tele-ophthalmic models of care. Tele-ophthalmic models of care can be used for consultative service, screening, triage and remote supervision. The majority of services were for general eye care and triage (n = 17; 26%) or emergency services (n = 8; 12%). The most common conditions for disease-specific models of care were diabetic retinopathy (n = 14; 21%), and glaucoma (n = 8; 12%). Most models of care involved local clinicians capturing images and transmitting them to an ophthalmologist for assessment. This scoping review demonstrated tele-ophthalmology to be feasible for consultation, screening, triage and remote supervision applications across a broad range of ophthalmic conditions. A large number of models of care have been identified and described in this review. Considerable collaboration between patient-end clinicians and substantial infrastructure is typically required for tele-ophthalmology.

Davalos, M. E., French, M. T., Burdick, A. E., et al. (2009). "Economic evaluation of telemedicine: review of the literature and research guidelines for benefit-cost analysis." *Telemed J E Health* **15**(10): 933-948.

Telemedicine programs provide specialty health services to remote populations using telecommunications technology. This innovative approach to medical care delivery has been expanding for several years and currently covers various specialty areas such as cardiology, dermatology, and pediatrics. Economic evaluations of telemedicine, however, remain rare, and few of those conducted have accounted for the wide range of economic costs and benefits. Rigorous benefit-cost analyses of telemedicine programs could provide credible and comparative evidence of their economic viability and thus lead to the adoption and/or expansion of the most successful programs. To facilitate more advanced economic evaluations, this article presents research guidelines for conducting benefit-cost analyses of telemedicine programs, emphasizing opportunity cost estimation, commonly used program outcomes, and monetary conversion factors to translate outcomes to dollar values. The article concludes with specific recommendations for future research.

Ekeland, A. G., Bowes, A. et Flottorp, S. (2010). "Effectiveness of telemedicine: a systematic review of reviews." *Int J Med Inform* **79**(11): 736-771.

OBJECTIVES: To conduct a review of reviews on the impacts and costs of telemedicine services. **METHODS:** A review of systematic reviews of telemedicine interventions was conducted. Interventions included all e-health interventions, information and communication technologies for communication in health care, Internet based interventions for diagnosis and treatments, and social care if important part of health care and in collaboration with health care for patients with chronic conditions were considered relevant. Each potentially relevant systematic review was assessed in full text by one member of an external expert team, using a revised check list from EPOC (Cochrane Effective Practice and Organisation of Care Group) to assess quality. Qualitative analysis of the included reviews was informed by principles of realist review. **RESULTS:** In total 1593 titles/abstracts were identified. Following quality assessment, the review included 80 heterogeneous systematic reviews. Twenty-one reviews concluded that telemedicine is effective, 18 found that evidence is promising but incomplete and others that evidence is limited and inconsistent. Emerging themes are the particularly problematic nature of economic analyses of telemedicine, the benefits of telemedicine for patients, and telemedicine as complex and ongoing collaborative achievements in unpredictable processes. **CONCLUSIONS:** The emergence of new topic areas in this dynamic field is notable and reviewers are starting to explore new questions beyond those of clinical and cost-effectiveness. Reviewers point to a continuing need for larger studies of telemedicine as controlled interventions, and more focus on patients' perspectives, economic analyses and on telemedicine innovations as complex processes and ongoing collaborative achievements. Formative assessments are emerging as an area of interest.

Ekeland, A. G., Bowes, A. et Flottorp, S. (2012). "Methodologies for assessing telemedicine: a systematic review of reviews." *Int J Med Inform* **81**(1): 1-11.

BACKGROUND AND OBJECTIVES: Previous reviews have expressed concerns about the quality of telemedicine studies. There is debate about shortcomings and appropriate methodologies. The aim of this review of systematic reviews of telemedicine is to summarize methodologies used in telemedicine research, discuss knowledge gaps and recommendations and suggest methodological approaches for further research. **METHODS:** We conducted a review of systematic reviews of telemedicine according to a protocol listing explicit methods, selection criteria, data collection and quality assessment procedures. We included reviews where authors explicitly addressed and made recommendations for assessment methodologies. We did a qualitative analysis of the reviews included, sensitized by two broad methodological positions; positivist and naturalistic approaches. The analysis focused on methodologies used in the primary studies included in the reviews as reported by the review authors, and methodological recommendations made by the review authors. **RESULTS:** We identified 1593 titles/abstracts. We included 50 reviews that explicitly addressed assessment methodologies. One group of reviews recommended larger and more rigorously designed controlled studies to assess the impacts of telemedicine; a second group proposed standardisation of populations, and/or interventions and outcome measures to reduce heterogeneity and facilitate meta-analysis; a third group recommended combining quantitative and qualitative research methods; and others applying different naturalistic approaches including methodologies addressing mutual adaptations of services and users; politically driven action research and formative research aimed at collaboration to ensure capacity for improvement of services in natural settings. **CONCLUSIONS:** Larger and more rigorous studies are crucial for the production of evidence of effectiveness of unambiguous telemedicine services for pre defined outcome measures. Summative methodologies acknowledging telemedicine as complex innovations and outcomes as partly contingent on values, meanings and contexts are also important. So are formative, naturalistic methodologies that acknowledge

telemedicine as ongoing collaborative achievements and engage with stakeholders, including patients to produce and conceptualise new and effective telemedicine innovations.

Flodgren, G., Rachas, A., Farmer, A. J., et al. (2015). "Interactive telemedicine: effects on professional practice and health care outcomes." *Cochrane Database Syst Rev*(9): Cd002098.

BACKGROUND: Telemedicine (TM) is the use of telecommunication systems to deliver health care at a distance. It has the potential to improve patient health outcomes, access to health care and reduce healthcare costs. As TM applications continue to evolve it is important to understand the impact TM might have on patients, healthcare professionals and the organisation of care. **OBJECTIVES:** To assess the effectiveness, acceptability and costs of interactive TM as an alternative to, or in addition to, usual care (i.e. face-to-face care, or telephone consultation). **SEARCH METHODS:** We searched the Effective Practice and Organisation of Care (EPOC) Group's specialised register, CENTRAL, MEDLINE, EMBASE, five other databases and two trials registers to June 2013, together with reference checking, citation searching, handsearching and contact with study authors to identify additional studies. **SELECTION CRITERIA:** We considered randomised controlled trials of interactive TM that involved direct patient-provider interaction and was delivered in addition to, or substituting for, usual care compared with usual care alone, to participants with any clinical condition. We excluded telephone only interventions and wholly automatic self-management TM interventions. **DATA COLLECTION AND ANALYSIS:** For each condition, we pooled outcome data that were sufficiently homogenous using fixed effect meta-analysis. We reported risk ratios (RR) and 95% confidence intervals (CI) for dichotomous outcomes, and mean differences (MD) for continuous outcomes. **MAIN RESULTS:** We included 93 eligible trials (N = 22,047 participants), which evaluated the effectiveness of interactive TM delivered in addition to (32% of studies), as an alternative to (57% of studies), or partly substituted for usual care (11%) as compared to usual care alone. The included studies recruited patients with the following clinical conditions: cardiovascular disease (36), diabetes (21), respiratory conditions (9), mental health or substance abuse conditions (7), conditions requiring a specialist consultation (6), co morbidities (3), urogenital conditions (3), neurological injuries and conditions (2), gastrointestinal conditions (2), neonatal conditions requiring specialist care (2), solid organ transplantation (1), and cancer (1). Telemedicine provided remote monitoring (55 studies), or real-time video-conferencing (38 studies), which was used either alone or in combination. The main TM function varied depending on clinical condition, but fell typically into one of the following six categories, with some overlap: i) monitoring of a chronic condition to detect early signs of deterioration and prompt treatment and advice, (41); ii) provision of treatment or rehabilitation (12), for example the delivery of cognitive behavioural therapy, or incontinence training; iii) education and advice for self-management (23), for example nurses delivering education to patients with diabetes or providing support to parents of very low birth weight infants or to patients with home parenteral nutrition; iv) specialist consultations for diagnosis and treatment decisions (8), v) real-time assessment of clinical status, for example post-operative assessment after minor operation or follow-up after solid organ transplantation (8) vi), screening, for angina (1). The type of data transmitted by the patient, the frequency of data transfer, (e.g. telephone, e-mail, SMS) and frequency of interactions between patient and healthcare provider varied across studies, as did the type of healthcare provider/s and healthcare system involved in delivering the intervention. We found no difference between groups for all-cause mortality for patients with heart failure (16 studies; N = 5239; RR:0.89, 95% CI 0.76 to 1.03, P = 0.12; I(2) = 44%) (moderate to high certainty of evidence) at a median of six months follow-up. Admissions to hospital (11 studies; N = 4529) ranged from a decrease of 64% to an increase of 60% at median eight months follow-up (moderate certainty of evidence). We found some evidence of improved quality of life (five studies; N = 482; MD:-4.39, 95% CI -7.94 to -0.83; P

< 0.02; I(2) = 0%) (moderate certainty of evidence) for those allocated to TM as compared with usual care at a median three months follow-up. In studies recruiting participants with diabetes (16 studies; N = 2768) we found lower glycosylated haemoglobin (HbA1c %) levels in those allocated to TM than in controls (MD -0.31, 95% CI -0.37 to -0.24; P < 0.00001; I(2)= 42%, P = 0.04) (high certainty of evidence) at a median of nine months follow-up. We found some evidence for a decrease in LDL (four studies, N = 1692; MD -12.45, 95% CI -14.23 to -10.68; P < 0.00001; I(2) = 0%) (moderate certainty of evidence), and blood pressure (four studies, N = 1770: MD: SBP:-4.33, 95% CI -5.30 to -3.35, P < 0.00001; I(2) = 17%; DBP: -2.75 95% CI -3.28 to -2.22, P < 0.00001; I(2) = 45% (moderate certainty evidence), in TM as compared with usual care. Seven studies that recruited participants with different mental health and substance abuse problems, reported no differences in the effect of therapy delivered over video-conferencing, as compared to face-to-face delivery. Findings from the other studies were inconsistent; there was some evidence that monitoring via TM improved blood pressure control in participants with hypertension, and a few studies reported improved symptom scores for those with a respiratory condition. Studies recruiting participants requiring mental health services and those requiring specialist consultation for a dermatological condition reported no differences between groups. AUTHORS' CONCLUSIONS: The findings in our review indicate that the use of TM in the management of heart failure appears to lead to similar health outcomes as face-to-face or telephone delivery of care; there is evidence that TM can improve the control of blood glucose in those with diabetes. The cost to a health service, and acceptability by patients and healthcare professionals, is not clear due to limited data reported for these outcomes. The effectiveness of TM may depend on a number of different factors, including those related to the study population e.g. the severity of the condition and the disease trajectory of the participants, the function of the intervention e.g., if it is used for monitoring a chronic condition, or to provide access to diagnostic services, as well as the healthcare provider and healthcare system involved in delivering the intervention.

Frade, S. et Rodrigues, H. (2013). "Benefits, challenges and impact of teleconsultation - a literature review." *Stud Health Technol Inform* **192**: 1157.

Teleconsultation involves the use of technology so that the medical professionals and patients can interact with each other bringing health to where ever it is needed. Although it has been demonstrated to be feasible and effective its sustainability remains an important question. This paper presents the results of a literature review on teleconsultation, based on the Portuguese context. Although Portugal has some successful projects, a national or international conjoint effort would be more fruitful. Technologically it gets lets costly to provide teleconsultation, as pervasive computing grows. The gap of benefits between teleconsultation and regular consultation will diminish as patients grow fonder into technology. The economic value of this type of consultation remains a difficult subject, so a small budget economic analysis, based on a break-even method, is suggested. This analysis conducted on Finland shows that teleconsultation can be cost-effective.

French, B., Day, E., Watkins, C., et al. (2013). "The challenges of implementing a telestroke network: a systematic review and case study." *BMC Med Inform Decis Mak* **13**: 125.

BACKGROUND: The use of telemedicine in acute stroke care can facilitate rapid access to treatment, but the work required to embed any new technology into routine practice is often hidden, and can be challenging. We aimed to collate recommendations and resources to support telestroke implementation. METHODS: Systematic search of healthcare databases and the Internet to identify descriptions of the implementation of telestroke projects; interviews with key stakeholders during the development of one UK telestroke network.

Supporting documentation from existing projects was analysed to construct a framework of implementation stages and tasks, and a toolkit of documents. Interviews and literature were analysed with other data sources using Normalisation Process Theory as described in the e-Health Implementation Toolkit. RESULTS: 61 telestroke projects were identified and contacted. Twenty projects provided documents, 13 with published research detailing four stages of telestroke system development, implementation, use, and evaluation. Interviewees identified four main challenges: engaging and maintaining the commitment of a wide range of stakeholders across multiple organisations; addressing clinicians perceptions of evidence, workload, and payback; managing clinical and technical workability across diverse settings; and monitoring how the system is used and reconfigured by users. CONCLUSIONS: Information to guide telestroke implementation is sparse, but available. By using multiple sources of data, sufficient information was collated to construct a web-based toolkit detailing implementation tasks, resources and challenges in the development of a telestroke system for assessment and thrombolysis delivery in acute care. The toolkit is freely available online.

Gagnon, M. P., Beogo, I. et Buyl, R. (2016). "e-Health Interventions for Healthy Aging: A Systematic Review Protocol." *Stud Health Technol Inform* **225**: 954-955.

e-Health interventions could contribute to healthy aging (HA) but their effectiveness has not been synthesised. This study aims to systematically review the effectiveness of e-health interventions for supporting HA. We will perform standardized searches to identify experimental and quasi-experimental studies evaluating the effectiveness of e-health interventions for HA. Outcomes of interest are: wellbeing, quality of life, activities of daily living, leisure activities, knowledge, evaluation of care, social support, skill acquisition and healthy behaviours. We will also consider adverse effects such as social isolation, anxiety, and burden on informal caregivers. Two reviewers will independently assess studies for inclusion and extract data using a standardised tool. We will calculate effect sizes related to e-health interventions. If not possible, we will present the findings in a narrative form. This systematic review will provide unique knowledge on the effectiveness of e-health interventions for supporting HA.

Gorin, S. S., Haggstrom, D., Han, P. K. J., et al. (2017). "Cancer Care Coordination: a Systematic Review and Meta-Analysis of Over 30 Years of Empirical Studies." *Ann Behav Med* **51**(4): 532-546.

BACKGROUND: According to a landmark study by the Institute of Medicine, patients with cancer often receive poorly coordinated care in multiple settings from many providers. Lack of coordination is associated with poor symptom control, medical errors, and higher costs. PURPOSE: The aims of this systematic review and meta-analysis were to (1) synthesize the findings of studies addressing cancer care coordination, (2) describe study outcomes across the cancer continuum, and (3) obtain a quantitative estimate of the effect of interventions in cancer care coordination on service system processes and patient health outcomes. METHODS: Of 1241 abstracts identified through MEDLINE, EMBASE, CINAHL, and the Cochrane Library, 52 studies met the inclusion criteria. Each study had US or Canadian participants, comparison or control groups, measures, times, samples, and/or interventions. Two researchers independently applied a standardized search strategy, coding scheme, and online coding program to each study. Eleven studies met the additional criteria for the meta-analysis; a random effects estimation model was used for data analysis. RESULTS: Cancer care coordination approaches led to improvements in 81 % of outcomes, including screening, measures of patient experience with care, and quality of end-of-life care. Across the continuum of cancer care, patient navigation was the most frequent care coordination intervention, followed by home telehealth; nurse case management was third in frequency. The meta-analysis of a subset of the reviewed studies showed that the odds of appropriate

health care utilization in cancer care coordination interventions were almost twice (OR = 1.9, 95 % CI = 1.5-3.5) that of comparison interventions. CONCLUSIONS: This review offers promising findings on the impact of cancer care coordination on increasing value and reducing healthcare costs in the USA.

HAS (2011). Efficience de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS: 41 , tabl., fig.

http://www.has-sante.fr/portail/upload/docs/application/pdf/2011-06/cadrage_telemedecine_vf.pdf

Cette note de cadrage concerne la mise en œuvre d'une évaluation médico-économique de la télémédecine par un état des lieux de la littérature internationale. Cette évaluation s'inscrit dans une optique d'aide à la décision publique. Elle vise à apporter des éléments de cadrage sur le déploiement de la télémédecine en France concernant les trois objectifs suivants : Contribuer à la définition d'axes prioritaires de déploiement de la télémédecine à partir de l'identification des projets pilotes et expérimentations les plus efficaces ; proposer un cadre d'évaluation médico-économique en fonction des indicateurs recensés et d'une classification des projets de télémédecine ; identifier des modèles économiques afin de proposer des éléments permettant d'orienter la politique de financement. La réalisation de cette évaluation a pour origine la volonté des pouvoirs publics et des acteurs de terrain de déployer la télémédecine en France. A la suite du décret relatif à la télémédecine publié en octobre 2010, la Direction Générale de l'organisation des soins a annoncé, début 2011, la mise en place d'un plan triennal de déploiement national de la télémédecine. Dans cette dynamique actuelle, les attentes du demandeur sont doubles : d'une part, contribuer à alimenter les axes d'orientation de la politique de déploiement de la télémédecine, et, d'autre part, proposer des outils d'évaluation des expérimentations et projets pilotes concernant les aspects médico-économiques

HAS (2013). Efficience de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS: 154 , tabl., fig., ann.

http://esante.gouv.fr/sites/default/files/2013_07_Rapport_HAS_TLM.pdf

La télémédecine est une forme de pratique médicale à distance fondée sur l'utilisation des technologies de l'information et de la communication, qui fait l'objet depuis 2011 d'une stratégie nationale de déploiement. Les attentes autour de la télémédecine sont aujourd'hui très importantes et son développement confronte les pouvoirs publics, les patients et les professionnels à de nouvelles problématiques, en particulier celle de l'évaluation médico-économique des projets. La demande de la DGOS à l'origine de ce rapport s'inscrit dans une optique d'aide à la décision publique. A partir d'une revue de la littérature internationale portant sur l'évaluation médico-économique de la télémédecine, sans délimitation du champ à un domaine d'application spécifique, l'objectif de ce rapport est double : Réaliser un état des lieux des études d'évaluation médico-économique de la télémédecine et apprécier l'apport de cette littérature pour alimenter les réflexions concernant la question de l'efficacité de cette forme de pratique médicale, la définition d'axes de déploiement et l'identification de modèles de financement ; Proposer un cadre d'évaluation médico-économique afin de favoriser la mise en œuvre d'évaluations dans le contexte français.

Kidholm, K., Clemensen, J., Caffery, L. J., et al. (2017). "The Model for Assessment of Telemedicine (MAST): A scoping review of empirical studies." J Telemed Telecare **23**(9): 803-813.

The evaluation of telemedicine can be achieved using different evaluation models or theoretical frameworks. This paper presents a scoping review of published studies which

have applied the Model for Assessment of Telemedicine (MAST). MAST includes pre-implementation assessment (e.g. by use of participatory design), followed by multidisciplinary assessment, including description of the patients and the application and assessment of safety, clinical effectiveness, patient perspectives, economic aspects organisational aspects and socio-cultural, legal and ethical aspects. Twenty-two studies met the inclusion criteria and were included in the review. In this article, research design and methods used in the multidisciplinary assessment are described, strengths and weaknesses are analysed, and recommendations for future research are presented.

Koutras, C., Bitsaki, M., Koutras, G., et al. (2015). "Socioeconomic impact of e-Health services in major joint replacement: A scoping review." *Technol Health Care* **23**(6): 809-817.

BACKGROUND: e-Health is a widespread healthcare practice in the medical community, supported by technology-based applications aiming to deliver health services in an efficient manner, improving the quality of life and providing a wide range of health and socio-economic benefits to patients. **OBJECTIVE:** To investigate the use of e-Health and mobile applications for the follow-up of major joint arthroplasty patients and the socio-economic impact of e-Health services on arthroplasty patients. **METHODS:** Studies published after 2000 in English language, enrolling patients who underwent total knee or hip replacement, applying e-Health solutions and highlighting the economic benefits obtained by patients, doctors and healthcare systems were considered for inclusion in the present study. **RESULTS:** Five studies satisfied our inclusion criteria and were included in qualitative analysis. In this paper, the use of e-Health for the follow-up of major joint arthroplasty patients and the positive impact in terms of cost, time and hospital visits reduction by applying e-Health solutions on arthroplasty patients are reviewed in detail as reported in the included studies. **CONCLUSION:** The majority of the included studies reported a positive impact in terms of cost, time and hospital visits reduction.

McLean, S., Chandler, D., Nurmatov, U., et al. (2011). "Telehealthcare for asthma: a Cochrane review." *Cmaj* **183**(11): E733-742.

BACKGROUND: Telehealthcare has the potential to provide care for long-term conditions that are increasingly prevalent, such as asthma. We conducted a systematic review of studies of telehealthcare interventions used for the treatment of asthma to determine whether such approaches to care are effective. **METHODS:** We searched the Cochrane Airways Group Specialised Register of Trials, which is derived from systematic searches of bibliographic databases including CENTRAL (the Cochrane Central Register of Controlled Trials), MEDLINE, Embase, CINAHL (Cumulative Index to Nursing and Allied Health Literature) and PsycINFO, as well as other electronic resources. We also searched registers of ongoing and unpublished trials. We were interested in studies that measured the following outcomes: quality of life, number of visits to the emergency department and number of admissions to hospital. Two reviewers identified studies for inclusion in our meta-analysis. We extracted data and used fixedeffect modelling for the meta-analyses. **RESULTS:** We identified 21 randomized controlled trials for inclusion in our analysis. The methods of telehealthcare intervention these studies investigated were the telephone and video- and Internet-based models of care. Meta-analysis did not show a clinically important improvement in patients' quality of life, and there was no significant change in the number of visits to the emergency department over 12 months. There was a significant reduction in the number of patients admitted to hospital once or more over 12 months (risk ratio 0.25 [95% confidence interval 0.09 to 0.66]). **INTERPRETATION:** We found no evidence of a clinically important impact on patients' quality of life, but telehealthcare interventions do appear to have the potential to reduce the risk of

admission to hospital, particularly for patients with severe asthma. Further research is required to clarify the cost-effectiveness of models of care based on telehealthcare.

Meachael, P., Nemser, B., Cosmaciuc, R., et al. (2012). "Capitalizing on the characteristics of mHealth to evaluate its impact." *J Health Commun* **17 Suppl 1**: 62-66.

The field of mHealth has made significant advances in a short period of time, demanding a more thorough and scientific approach to understanding and evaluating its progress. A recent review of mHealth literature identified two primary research needs in order for mHealth to strengthen health systems and promote healthy behaviors, namely health outcomes and cost-benefits (Meachael et al., 2010). In direct response to the gaps identified in mHealth research, the aim of this paper is to present the study design and highlight key observations and next steps from an evaluation of the mHealth activities within the electronic health (eHealth) architecture implemented by the Millennium Villages Project (MVP) by leveraging data generated through mobile technology itself alongside complementary qualitative research and costing assessments. The study, funded by the International Development and Research Centre (IDRC) as part of the Open Architecture Standards and Information Systems research project (OASIS II) (Sinha, 2009), is being implemented on data generated by 14 MVP sites in 10 Sub-Saharan African countries including more in-depth research in Ghana, Rwanda, Tanzania, and Uganda. Specific components of the study include rigorous quantitative case-control analyses and other epidemiological approaches (such as survival analysis) supplemented by in-depth qualitative interviews spread out over 18 months, as well as a costing study to assess the impact of mHealth on health outcomes, service delivery, and efficiency.

Midy, F. (1998). La télémédecine : document de travail. *Rapport CreDES*. Paris CREDES: 31.

A partir d'une revue de la littérature (Medline, base documentaire du CreDES...), ce rapport bibliographique tente tout d'abord une définition de la télémédecine. Il en définit ensuite les enjeux, et fait une évaluation à la fois médicale et économique de ces nouvelles technologies. Il comprend, en annexe, une liste des expérimentations en obstétrique, ainsi qu'une évaluation des résultats du point de vue des décideurs publics, des patientes et des praticiens.

Midy, F., Polton, D., Strauss, A., et al. (2000). Télémédecine & évaluation. Aide méthodologique à l'évaluation de la télémédecine. *Rapport CreDES*. Paris M.S.S.P.S.: 80, tabl., graph.

Ce document a pour objectif de faire le point sur ce qu'il est raisonnable d'envisager en termes d'évaluation dans le domaine de la télémédecine. Dans un premier chapitre, les auteurs délimitent leur champ de réflexion en précisant les attendus de l'implantation de la télémédecine ainsi que les objectifs de l'évaluation. Ils font le point dans un deuxième chapitre sur les expériences qui sont décrites dans la littérature internationale et qui présentent un intérêt en termes d'évaluation. Les expériences (françaises et québécoises), pour lesquelles les auteurs ont mené une observation directe sont synthétisées dans le troisième chapitre. Le quatrième chapitre décline quelques principes généraux d'évaluation sous la forme d'un guide d'aide à l'évaluation illustré par des exemples.

Michaud, T. L., Zhou, J., McCarthy, M. A., et al. (2018). "COSTS OF HOME-BASED TELEMEDICINE PROGRAMS: A SYSTEMATIC REVIEW." *Int J Technol Assess Health Care* **34**(4): 410-418.

OBJECTIVES: The aim of this study was to systematically investigate existing literature on the costs of home-based telemedicine programs, and to further summarize how the costs of

these telemedicine programs vary by equipment and services provided. **METHODS:** We undertook a systematic review of related literature by searching electronic bibliographic databases and identifying studies published from January 1, 2000, to November 30, 2017. The search was restricted to studies published in English, results from adult patients, and evaluation of home telemedicine programs implemented in the United States. Summarized telemedicine costs per unit of outcome measures were reported. **RESULTS:** Twelve studies were eligible for our review. The overall annual cost of providing home-based telemedicine varied substantially depending on specific chronic conditions, ranging from USD1,352 for heart failure to USD206,718 for congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes as a whole. The estimated cost per-patient-visit ranged from USD24 for cancer to USD39 for CHF, COPD, or chronic wound care. **CONCLUSIONS:** The costs of home-based telemedicine programs varied substantially by program components, disease type, equipment used, and services provided. All the selected studies indicated that home telemedicine programs reduced care costs, although detailed cost data were either incomplete or not presented in detail. A comprehensive analysis of the cost of home-based telemedicine programs and their determinants is still required before the cost efficiency of these programs can be better understood, which becomes crucial for these programs to be more widely adopted and reimbursed.

Mistry, H., Garnvwa, H. et Opong, R. (2014). "Critical appraisal of published systematic reviews assessing the cost-effectiveness of telemedicine studies." *Telemed J E Health* **20**(7): 609-618.

BACKGROUND: Over the last 10 years several systematic reviews have been published on the cost-effectiveness of telemedicine studies. Most reviews have concluded that there is not much difference in the cost-effectiveness when delivering health services via telemedicine or by conventional means. We are not aware of any systematic review looking at the systematic reviews of cost-effectiveness of telemedicine. This study was designed to identify published systematic reviews on the cost-effectiveness of telemedicine studies and to undertake a quality assessment of the identified systematic reviews. **MATERIALS AND METHODS:** We searched six electronic databases, including Medline, Embase, and the NHS Economic Evaluation Database, combining "review" terms with "telemedicine" terms to identify systematic reviews. **RESULTS:** We identified 4,116 potential abstracts. Nine systematic reviews met the inclusion criteria, which looked at the cost-effectiveness of telemedicine in general. All reviews were similar in terms of their stated purpose, and the objectives were clear. Three of the reviews did not use a checklist for the economic evaluation studies included in their review. The quality assessment found that five of the nine reviews had minimal flaws. **CONCLUSIONS:** Even though the general quality of reporting of the reviews was fine, we have found that conclusions cannot be drawn on the cost-effectiveness of telemedicine applications based on the methodological flaws in the economic analysis of the studies included in the reviews. Over time, reporting of cost-effectiveness has generally improved; however, there is still room for improvement, and authors need to use the recommended checklists for economic evaluations.

Mistry, H. (2012). "Systematic review of studies of the cost-effectiveness of telemedicine and telecare. Changes in the economic evidence over twenty years." *J Telemed Telecare* **18**(1): 1-6.

A systematic review of studies of the cost-effectiveness of telemedicine and telecare was undertaken from 1990 until September 2010. Twelve databases were searched, using economic evaluation terms combined with telemedicine terms. The search identified 80 studies which were classed as full economic evaluations; the majority (38) were cost-consequence analyses. There were 15 cost-effectiveness analyses (CEA) and seven cost-utility analyses (CUA). In the period January 2004 to September 2010 there were 47 studies. Eleven

were CEA and seven were CUA. Economic tools are being increasingly used for telemedicine and telecare studies, although better reporting of the methodologies and findings of the economic evaluations is required. Nonetheless, the results of the review were consistent with previous findings, i.e. there is no further conclusive evidence that telemedicine and telecare interventions are cost-effective compared to conventional health care.

Peeters, J. M., Mistiaen, P. et Francke, A. L. (2011). "Costs and financial benefits of video communication compared to usual care at home: a systematic review." *J Telemed Telecare* **17**(8): 403-411.

We conducted a systematic review of video communication in home care to provide insight into the ratio between the costs and financial benefits (i.e. cost savings). Four databases (PUBMED, EMBASE, COCHRANE LIBRARY, CINAHL) were searched for studies on video communication for patients living at home (up to December 2009). Studies were only included when data about the costs of video communication as well as the financial benefits were presented. The methodological quality of the included studies was assessed. Nine studies, mainly conducted in the US, met the inclusion criteria. The methodological quality was poor, except for one study. Most studies (8 of the 9) did not demonstrate that the financial benefits were significantly greater than the costs of video communication. One study - the only one with a high methodological quality - found that costs for patients who received video communication were higher than for patients who received traditional care. The review found no evidence that the cost of implementing video communication in home care was lower than the resulting financial benefits. More methodologically well conducted research is needed.

Puskin, D. S., Cohen, Z., Ferguson, A. S., et al. (2010). "Implementation and evaluation of telehealth tools and technologies." *Telemed J E Health* **16**(1): 96-102.

In June 2009, the National Center for Research Resources (NCRR), National Institutes of Health (NIH), convened a conference of experts to discuss future directions for research in addressing healthcare disparities through the use of telehealth technologies. As part of this conference, a panel was convened to review the status of current efforts to assess, implement, and evaluate telehealth technologies, and to recommend future directions for research. The panel members provided a series of practical recommendations to those who are contemplating establishing a telehealth service, as well as recommendations to the NIH on future funding for telehealth research. The recommendations to the NIH focused on three broad areas of concern: (1) technology assessment, (2) evaluation, and (3) technical assistance, education, and dissemination. The panel members emphasized the need for NIH to support research in areas that have been seriously underfunded in the past, including but not limited to primary care research, multisite collaborative telehealth studies, nonphysician telehealth services, and methodological development to develop a "gold standard" for telehealth studies.

Saliba, V., Legido-Quigley, H., Hallik, R., et al. (2012). "Telemedicine across borders: a systematic review of factors that hinder or support implementation." *Int J Med Inform* **81**(12): 793-809.

PURPOSE: Innovative technologies to deliver health care across borders have attracted both evangelists and sceptics. Our aim was to systematically identify factors that hinder or support implementation of cross-border telemedicine services worldwide in the last two decades.
METHODS: Two reviewers independently searched ten databases including MEDLINE and EMBASE, in June 2011 including citations from 1990 onwards when at least an abstract was available in English. We also searched ELDIS and INTUTE databases and Internet search

engines to identify grey literature. We included studies which (a) described the use of telemedicine to deliver cross-border healthcare and, or (b) described the factors that hinder or support implementation of cross-border telemedicine services. All study designs were included. Two reviewers independently assessed titles and abstracts of articles identified. Papers were allocated to one of four reviewers who extracted relevant data and validated it. We took a qualitative approach to the analysis, conducting a narrative synthesis of the evidence. RESULTS: 6026 records were identified of which 5806 were excluded following screening of titles and abstracts. We assessed 227 full text articles, excluding 133 because they were fatally flawed or did not meet the inclusion criteria, producing a final sample of 94. They involved 76 countries worldwide, most involving collaborations between high and low or middle income countries. Most described services delivering a combination of types of telemedicine but specialties most represented were telepathology, telesurgery, Emergency and trauma telemedicine and teleradiology. Most link health professionals, with only a few linking professionals directly to patients. A main driver for the development of cross-border telemedicine is the need to improve access to specialist services in low and middle income countries and in underserved rural areas in high income countries. Factors that hinder or support implementation clustered into four main themes: (1) legal factors; (2) sustainability factors; (3) cultural factors; and (4) contextual factors. CONCLUSIONS: National telemedicine programmes may build infrastructure and change mindsets, laying the foundations for successful engagement in cross-border services. Regional networks can also help with sharing of expertise and innovative ways of overcoming barriers to the implementation of services. Strong team leadership, training, flexible and locally responsive services delivered at low cost, using simple technologies, and within a clear legal and regulatory framework, are all important factors for the successful implementation of cross-border telemedicine services.

Sanyal, C., Stolee, P., Juzwishin, D., et al. (2018). "Economic evaluations of eHealth technologies: A systematic review." *PLoS One* **13**(6): e0198112.

BACKGROUND: Innovations in eHealth technologies have the potential to help older adults live independently, maintain their quality of life, and to reduce their health system dependency and health care expenditure. The objective of this study was to systematically review and appraise the quality of cost-effectiveness or utility studies assessing eHealth technologies in study populations involving older adults. METHODS: We systematically searched multiple databases (MEDLINE, EMBASE, CINAHL, NHS EED, and PsycINFO) for peer-reviewed studies published in English from 2000 to 2016 that examined cost-effectiveness (or utility) of eHealth technologies. The reporting quality of included studies was appraised using the Consolidated Health Economic Evaluation Reporting Standards statement. RESULTS: Eleven full text articles met the inclusion criteria representing public and private health care systems. eHealth technologies evaluated by these studies includes computerized decision support system, a web-based physical activity intervention, internet-delivered cognitive behavioral therapy, telecare, and telehealth. Overall, the reporting quality of the studies included in the review was varied. Most studies demonstrated efficacy and cost-effectiveness of an intervention using a randomized control trial and statistical modeling, respectively. This review found limited information on the feasibility of adopting these technologies based on economic and organizational factors. CONCLUSIONS: This review identified few economic evaluations of eHealth technologies that included older adults. The quality of the current evidence is limited and further research is warranted to clearly demonstrate the long-term cost-effectiveness of eHealth technologies from the health care system and societal perspectives.

Smith, A. C., Armfield, N. R., Croll, J., et al. (2012). "A review of Medicare expenditure in Australia for psychiatric consultations delivered in person and via videoconference." *J Telemed Telecare* **18**(3): 169-171.

We examined the activity (services recorded) and cost (benefits paid) of reimbursement associated with telepsychiatry services in the Australian public health-care sector. We reviewed the activity and costs administered through the government's Medicare Benefits Schedule (MBS) from July 2002 to June 2011. During this nine-year-period, almost 14 million psychiatric consultations were funded through Medicare at a cost of \$1.6 billion. Of these, 8003 were telepsychiatry consultations which cost \$934,000, i.e. the video consultations subgroup represented 0.06% of all psychiatric consultations provided and 0.06% of the total cost to the government for these services. Despite telepsychiatry being a widely reported and successful example of telehealth internationally, the uptake of telepsychiatry in Australia has been slow.

Vidal-Alaball, J., Garcia Domingo, J. L., Garcia Cuyas, F., et al. (2018). "A cost savings analysis of asynchronous teledermatology compared to face-to-face dermatology in Catalonia." *BMC Health Serv Res* **18**(1): 650.

BACKGROUND: A teledermatology pilot scheme was first conducted in the town of Manresa (Barcelona) in the summer of 2010. The clinical success of the scheme prompted its expansion to the whole county of Bages in 2011 and to the adjacent county of Bergueda in 2012. In the teledermatology service, primary care physicians take a photograph of the lesion and attach it to the electronic medical records of the patient together with a brief clinical account. In the referral hospital, the consultant dermatologists access the electronic medical records, review the images and suggest a treatment or action plan. Next, the primary care physicians review these recommendations and call the patient to report the results. This whole process is usually completed in less than 5 working days. **METHODS:** A cost saving analysis comparing teledermatology with dermatology face-to-face visits was performed in the county of Bages measuring the cost difference attributable to visits saved. **RESULTS:** The estimated added costs of the teledermatology service during 2016 amounted to 61,870 euro. For the same period, the estimated costs of traditional outpatient dermatology services were of 113,034 euro. This represents savings of 51,164 euro per year. After subtraction of societal costs, the savings equal 10,350 euro per year. **CONCLUSIONS:** Using a teledermatology service instead of face-to-face dermatology consultations could save 51,164 euro per year (11.4 euro per patient visited) in the county of Bages. Societal savings are the most significant.

Wade, V. A., Karnon, J., Elshaug, A. G., et al. (2010). "A systematic review of economic analyses of telehealth services using real time video communication." *BMC Health Serv Res* **10**: 233.

BACKGROUND: Telehealth is the delivery of health care at a distance, using information and communication technology. The major rationales for its introduction have been to decrease costs, improve efficiency and increase access in health care delivery. This systematic review assesses the economic value of one type of telehealth delivery--synchronous or real time video communication--rather than examining a heterogeneous range of delivery modes as has been the case with previous reviews in this area. **METHODS:** A systematic search was undertaken for economic analyses of the clinical use of telehealth, ending in June 2009. Studies with patient outcome data and a non-telehealth comparator were included. Cost analyses, non-comparative studies and those where patient satisfaction was the only health outcome were excluded. **RESULTS:** 36 articles met the inclusion criteria. 22(61%) of the studies found telehealth to be less costly than the non-telehealth alternative, 11(31%) found

greater costs and 3 (9%) gave the same or mixed results. 23 of the studies took the perspective of the health services, 12 were societal, and one was from the patient perspective. In three studies of telehealth to rural areas, the health services paid more for telehealth, but due to savings in patient travel, the societal perspective demonstrated cost savings. In regard to health outcomes, 12 (33%) of studies found improved health outcomes, 21 (58%) found outcomes were not significantly different, 2(6%) found that telehealth was less effective, and 1 (3%) found outcomes differed according to patient group. The organisational model of care was more important in determining the value of the service than the clinical discipline, the type of technology, or the date of the study. CONCLUSION: Delivery of health services by real time video communication was cost-effective for home care and access to on-call hospital specialists, showed mixed results for rural service delivery, and was not cost-effective for local delivery of services between hospitals and primary care.

LES ETUDES D'EVALUATION CLINIQUE : REVUES DE LITTERATURE

Aldehaim, A. Y., Alotaibi, F. F., Uphold, C. R., et al. (2016). "The Impact of Technology-Based Interventions on Informal Caregivers of Stroke Survivors: A Systematic Review." Telemed J E Health **22**(3): 223-231.

OBJECTIVE: This article is a systematic review of the impact of technology-based intervention on outcomes related to care providers for those who survived a stroke. MATERIALS AND METHODS: Literature was identified in the PubMed, PsycINFO, Scopus, and Cochrane databases for evidence on technology-based interventions for stroke survivors' caregivers. The search was restricted for all English-language articles from 1970 to February 2015 that implied technology-based interventions. This review included studies that measured the impact of these types of approaches on one or more of the following: depression and any of the following-problem-solving ability, burden, health status, social support, preparedness, and healthcare utilization by care recipient-as secondary outcomes. Telephone or face-to-face counseling sessions were not of interest for this review. The search strategy yielded five studies that met inclusion criteria: two randomized clinical trials and three pilot/preliminary studies, with diverse approaches and designs. RESULTS: Four studies have assessed the primary outcome, two of which reported significant decreases in caregivers' depressive symptoms. Two studies had measured each of the following outcomes-burden, problem-solving ability, health status, and social support-and they revealed no significant differences following the intervention. Only one study assessed caregivers' preparedness and showed improved posttest scores. Healthcare services use by the care recipient was assessed by one study, and the results indicated significant reduction in emergency department visits and hospital re-admissions. CONCLUSIONS: Despite various study designs and small sample sizes, available data suggest that an intervention that incorporates a theoretical-based model and is designed to target caregivers as early as possible is a promising strategy. Furthermore, there is a need to incorporate a cost-benefit analysis in future studies.

Anastasiadou, D., Folkvord, F. et Lupianez-Villanueva, F. (2018). "A systematic review of mHealth interventions for the support of eating disorders." Eur Eat Disord Rev **26**(5): 394-416.

OBJECTIVE: To systematically review the existing evidence of mobile health (mHealth) tools for the treatment of eating disorders (ED). METHOD: Electronic databases (Pubmed, PsycInfo, and SCOPUS) were searched, and PRISMA guidelines were followed. Selected studies were divided into three categories according to the intended purpose of the mHealth tools used: (a) sole means of support, (b) complementary to standard face-to-face treatment, and (c) for relapse prevention. Additionally, studies were assessed on efficacy, qualitative

information, and methodological quality. RESULTS: Fifteen studies were identified. Most studies using mHealth as a sole means of intervention or adjunct to traditional therapy showed no effects, although an improvement at postassessment was present in vodcast, smartphone application, and text-messaging interventions. Between group effects were only found for a text-messaging intervention for relapse prevention. Qualitative analyses showed that most mHealth interventions were considered as acceptable, supporting, and motivating by patients and therapists, although different important problems were observed in individual studies. CONCLUSIONS: Limited effects were found for mHealth interventions to reduce ED-related symptoms. A common evaluation framework for ED mHealth interventions should be proposed to assess the validity of interventions before implementing them on a larger scale in clinical practice.

Aquino, J. A., Baldoni, N. R., Flor, C. R., et al. (2018). "Effectiveness of individual strategies for the empowerment of patients with diabetes mellitus: A systematic review with meta-analysis." Prim Care Diabetes **12**(2): 97-110.

AIMS: To identify and evaluate the effectiveness of individual empowerment strategies in patients with diabetes mellitus (DM). METHODS: A systematic review was performed in the PubMed, Scopus, Science Direct and BVS. For meta-analysis and evaluation of Cochrane Risk and Bias, Revman V 5.2 software was used. RESULTS: Eleven studies of 1073 publications met the inclusion criteria. The strategies used were individual consultations, phone calls, sessions via a website and use of a booklet. Glycemic Hemoglobin (HbA1c) was used to evaluate the effectiveness of the strategies, and 45.4% of the studies also used the Diabetes Empowerment Scale. Five studies (45.5%) showed significant improvements in HbA1c reduction, improvements in self-efficacy (18.2%), knowledge levels of DM (18.2%), quality of life (18.2%). However, after meta-analysis, no statistically significant improvement was found for HbA1c. CONCLUSION: This systematic review showed that individual strategies for DM empowerment were not effective in reducing HbA1c, despite contributing to improvements in psychosocial parameters. Therefore, individual strategies need to be reviewed so that they become effective in DM control.

Bager, P., Chauhan, U., Greveson, K., et al. (2018). "Systematic review: advice lines for patients with inflammatory bowel disease." Scand J Gastroenterol **53**(5): 506-512.

OBJECTIVE: Advice lines for patients with inflammatory bowel diseases (IBD) have been introduced internationally. However, only a few publications have described the advice line service and evaluated the efficiency of it with many results presented as conference posters. A systematic synthesis of evidence is needed and the aim of this article was to systematically review the evidence of IBD advice lines. MATERIALS AND METHODS: A broad systematic literature search was performed to identify relevant studies addressing the effect of advice lines. The process of selection of the retrieved studies was undertaken in two phases. In phase one, all abstracts were reviewed by two independent reviewers. In phase two, the full text of all included studies were independently reviewed by two reviewers. The included studies underwent quality assessment and data synthesis. RESULTS: Ten published studies and 10 congress abstracts were included in the review. The studies were heterogeneous both in scientific quality and in the focus of the study. No rigorous evidence was found to support that advice lines improve disease activity in IBD and correspondingly no studies reported worsening in disease activity. Advice lines were found to be health economically beneficial with clear indications of the positive impact of advice lines from the patient perspective. CONCLUSION: The levels of evidence of the effect of advice lines in IBD are low. However, the use of advice lines was found to be safe, and cost-effective. Where investigated, patients

with IBD overwhelmingly welcome an advice line with high levels of patient satisfaction reported.

Barth, J., Nickel, F. et Kolominsky-Rabas, P. L. (2018). "Diagnosis of cognitive decline and dementia in rural areas - A scoping review." *Int J Geriatr Psychiatry* **33**(3): 459-474.

OBJECTIVES: Due to the demographic change, the global prevalence of dementia will continually rise. Barriers to diagnosis and care are still high. But timely diagnosis is associated with valuable benefits and can promote timely and optimal management. Receiving an early diagnosis is especially in rural areas a problem due to the limited access to assessments. Therefore, the aim of our scoping review is to investigate different interventions targeted at rural living elderly to screen and diagnose cognitive decline and dementia. **METHODS:** A scoping review was conducted in line with the framework of Arksey and O'Malley. The following databases were systematically searched: PubMed, PsycINFO, Cochrane Library, and ScienceDirect. The interventions were categorized in four main categories (interventions for general practitioners/institutions; online/mobile offers; telehealth applications; telephone-based screenings). **RESULTS:** Thirty studies were included. The four categories show different scopes of application. Telehealth applications show that it is feasible and valid to diagnose dementia via videoconference. Assessments described in three other categories show that remotely used tools are appropriate to screen for mild cognitive impairment or cognitive decline, but are not valid to establish a dementia diagnosis. **CONCLUSIONS:** Telehealth applications can appropriately be used to diagnose dementia. However, most of the studies included only small sample sizes and did not test the applications explicitly in rural or remote populations. Therefore, studies taking these limitations into account are needed. On top, only two RCTs are included in this review indicating that more high quality studies in this field are needed.

Bateman, D. R., Srinivas, B., Emmett, T. W., et al. (2017). "Categorizing Health Outcomes and Efficacy of mHealth Apps for Persons With Cognitive Impairment: A Systematic Review." *J Med Internet Res* **19**(8): e301.

BACKGROUND: Use of mobile health (mHealth) apps is growing at an exponential rate in the United States and around the world. Mild cognitive impairment (MCI), Alzheimer disease, and related dementias are a global health problem. Numerous mHealth interventions exist for this population, yet the effect of these interventions on health has not been systematically described. **OBJECTIVE:** The aim of this study is to catalog the types of health outcomes used to measure effectiveness of mHealth interventions and assess which mHealth interventions have been shown to improve the health of persons with MCI, Alzheimer disease, and dementia. **METHODS:** We searched 13 databases, including Ovid MEDLINE, PubMed, EMBASE, the full Cochrane Library, CINAHL, PsycINFO, Ei Compendex, IEEE Xplore, Applied Science & Technology Source, Scopus, Web of Science, ClinicalTrials.gov, and Google Scholar from inception through May 2017 for mHealth studies involving persons with cognitive impairment that were evaluated using at least one quantitative health outcome. Proceedings of the Annual ACM Conferences on Human Factors in Computing Systems, the ACM User Interface Software and Technology Symposium, and the IEEE International Symposium on Wearable Computers were searched in the ACM Digital Library from 2012 to 2016. A hand search of JMIR Publications journals was also completed in July 2017. **RESULTS:** After removal of duplicates, our initial search returned 3955 records. Of these articles, 24 met final inclusion criteria as studies involving mHealth interventions that measured at least one quantitative health outcome for persons with MCI, Alzheimer disease, and dementia. Common quantitative health outcomes included cognition, function, mood, and quality of life. We found that 21.2% (101/476) of the fully reviewed articles were excluded because of a

lack of health outcomes. The health outcomes selected were observed to be inconsistent between studies. For those studies with quantitative health outcomes, more than half (58%) reported postintervention improvements in outcomes. CONCLUSIONS: Results showed that many mHealth app interventions targeting those with cognitive impairment lack quantitative health outcomes as a part of their evaluation process and that there is a lack of consensus as to which outcomes to use. The majority of mHealth app interventions that incorporated health outcomes into their evaluation noted improvements in the health of persons with MCI, Alzheimer disease, and dementia. However, these studies were of low quality, leading to a grade C level of evidence. Clarification of the benefits of mHealth interventions for people with cognitive impairment requires more randomized controlled trials, larger numbers of participants, and trial designs that minimize bias. TRIAL REGISTRATION: PROSPERO Registration: PROSPERO 2016:CRD42016033846; http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016033846 (Archived by WebCite at <http://www.webcitation.org/6sjjwnv1M>).

Birkhoff, S. D. et Smeltzer, S. C. (2017). "Perceptions of Smartphone User-Centered Mobile Health Tracking Apps Across Various Chronic Illness Populations: An Integrative Review." J Nurs Scholarsh **49**(4): 371-378.

PURPOSE: This integrative review presents a synthesis of the current qualitative research addressing the motivating factors, usability, and experiences of mobile health tracking applications (apps) across various chronic disease populations. DESIGN: Integrative review of the literature. METHODS: Databases used to conduct this integrative review included: PubMed Plus, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Google Scholar, Science Direct, and EBSCO megafile. The following search terms were used in all five databases: smartphone apps, apps, mHealth, eHealth, mobile health apps, health tracking apps, user-centered apps, wireless technology, engagement, qualitative, and usability. FINDINGS: The initial literature review yielded 689 results. Once inclusion and exclusion criteria were employed, 11 studies met the criteria set forth for this review. The reviewed studies provided insight into users' perceptions, experiences, and motivations to incorporate smartphone mobile health apps into their daily lives when living with chronic illnesses. CONCLUSIONS: This review indicates the growing interest in user-centered mobile health tracking apps, but with little understanding of motivating factors that foster sustained app use. Mobile health tracking apps targeted to users with chronic conditions need to have a high level of usability in order to motivate users to sustain engagement with their mobile health tracking app. CLINICAL RELEVANCE: User-centered mobile health tracking app technology is being used with increasing frequency to potentially provide individualized support to chronic illness populations.

Blackburn, S., Brownsell, S. et Hawley, M. S. (2011). "A systematic review of digital interactive television systems and their applications in the health and social care fields." J Telemed Telecare **17**(4): 168-176.

We conducted a systematic review of the applications and technical features of digital interactive television (DITV) in the health and social care fields. The Web of Knowledge and IEEE Xplore databases were searched for articles published between January 2000 and March 2010 which related to DITV systems facilitating the communication of information to/from an individual's home with either a health or social care application. Out of 1679 articles retrieved, 42 met the inclusion criteria and were selected for review. An additional 20 articles were obtained from online grey literature sources. Twenty-five DITV systems operating in health and social care were identified, including seven commercial systems. The most common applications were related to health care, such as vital signs monitoring (68% of

systems) and health information or advice (56% of systems). The most common technical features of DITV systems were two-way communication (88%), medical peripherals (68%), on-screen messaging (48%) and video communication (36%). Digital interactive television has the potential to deliver health and social care to people in their own homes. However, the requirement for a high-bandwidth communications infrastructure, the usability of the systems, their level of personalisation and the lack of evidence regarding clinical and cost-effectiveness will all need to be addressed if this approach is to flourish.

Brunton, L., Bower, P. et Sanders, C. (2015). "The Contradictions of Telehealth User Experience in Chronic Obstructive Pulmonary Disease (COPD): A Qualitative Meta-Synthesis." *PLoS One* **10**(10): e0139561.

OBJECTIVE: As the global burden of chronic disease rises, policy makers are showing a strong interest in adopting telehealth technologies for use in long term condition management, including COPD. However, there remain barriers to its implementation and sustained use. To date, there has been limited qualitative investigation into how users (both patients/carers and staff) perceive and experience the technology. We aimed to systematically review and synthesise the findings from qualitative studies that investigated user perspectives and experiences of telehealth in COPD management, in order to identify factors which may impact on uptake. **METHOD:** Systematic review and meta-synthesis of published qualitative studies of user (patients, their carers and clinicians) experience of telehealth technologies for the management of Chronic Obstructive Pulmonary Disease. ASSIA, CINAHL, Embase, Medline, PsychInfo and Web of Knowledge databases were searched up to October 2014. Reference lists of included studies and reference lists of key papers were also searched. Quality appraisal was guided by an adapted version of the CASP qualitative appraisal tool. **FINDINGS:** 705 references (after duplicates removed) were identified and 10 papers, relating to 7 studies were included in the review. Most authors of included studies had identified both positive and negative experiences of telehealth use in the management of COPD. Through a line of argument synthesis we were able to derive new insights from the data to identify three overarching themes that have the ability to either impede or promote positive user experience of telehealth in COPD: the influence on moral dilemmas of help seeking- (enables dependency or self-care); transforming interactions (increases risk or reassurance) and reconfiguration of 'work' practices (causes burden or empowerment). **CONCLUSION:** Findings from this meta-synthesis have implications for the future design and implementation of telehealth services. Future research needs to include potential users at an earlier stage of telehealth/service development.

Cota, A., Tarchala, M., Parent-Harvey, C., et al. (2017). "Review of 5.5 Years' Experience Using E-mail-Based Telemedicine to Deliver Orthopedic Care to Remote Communities." *Telemed J E Health* **23**(1): 37-40.

INTRODUCTION: The use of e-mail-based telemedicine has been demonstrated as an effective and low-cost way of delivering healthcare to patients in remote areas who have limited access to medical services. We established a novel teleorthopedic service for a catchment area encompassing 972,000 km² using a commercial off-the-shelf e-mail application. Before the implementation of this program, patients with acute orthopedic injuries were required to travel by air up to 1,900 km for evaluation by an orthopedic surgeon. In the present study, we examined the patient demographics and consultation characteristics and calculated the cost savings associated with patient travel for this teleorthopedic service. **METHODS:** We retrospectively reviewed 1,000 consecutive e-mail-based consults and radiographic images received for new patients with acute orthopedic injuries from January 2008 to June 2013. Seventy-nine consults were excluded due to

incomplete documentation, leaving 921 available for analysis. The service records were examined to identify patient demographics, orthopedic diagnosis, the percentage of patients managed locally, and the medical indications for patients requiring transfer. As the travel costs for patients requiring transport to the university hospital center are borne by governmental health agencies, the savings accrued from treating patients in their home communities were also calculated. RESULTS: For the 921 consultations, the mean age of patients was 27 years (range, 3 months-88 years), with 40.7% of all patients being younger than 18 years. The most common diagnoses were ankle fractures (15.2%), clavicle fractures (11.2%), distal radius fractures (11.2%), and fractures of the foot (10.2%). One hundred ninety patients (20.6%) required transfer, whereas 731 patients (79.4%) were treated in their home communities. Of the patients who were transferred, 123 (64.7%) required surgery, 55 (28.9%) required clinical evaluation by an orthopedic surgeon, and 12 (6.4%) required CT or MRI. Cost savings related to return trip travel expenses were calculated to be \$5,538,120 Canadian (CAD) for the review period. SUMMARY: Using an e-mail-based teleorthopedic service to manage acutely injured patients in remote communities allowed 79% of patients to be treated locally, with travel-related cost savings of \$5,538,120 CAD.

Cox, A., Lucas, G., Marcu, A., et al. (2017). "Cancer Survivors' Experience With Telehealth: A Systematic Review and Thematic Synthesis." *J Med Internet Res* **19**(1): e11.

BACKGROUND: Net survival rates of cancer are increasing worldwide, placing a strain on health service provision. There is a drive to transfer the care of cancer survivors-individuals living with and beyond cancer-to the community and encourage them to play an active role in their own care. Telehealth, the use of technology in remote exchange of data and communication between patients and health care professionals (HCPs), is an important contributor to this evolving model of care. Telehealth interventions are "complex," and understanding patient experiences of them is important in evaluating their impact. However, a wider view of patient experience is lacking as qualitative studies detailing cancer survivor engagement with telehealth are yet to be synthesized. OBJECTIVE: To systematically identify, appraise, and synthesize qualitative research evidence on the experiences of adult cancer survivors participating in telehealth interventions, to characterize the patient experience of telehealth interventions for this group. METHODS: Medline (PubMed), PsychINFO, Cumulative Index for Nursing and Allied Health Professionals (CINAHL), Embase, and Cochrane Central Register of Controlled Trials were searched on August 14, 2015, and March 8, 2016, for English-language papers published between 2006 and 2016. Inclusion criteria were as follows: adult cancer survivors aged 18 years and over, cancer diagnosis, experience of participating in a telehealth intervention (defined as remote communication or remote monitoring with an HCP delivered by telephone, Internet, or hand-held or mobile technology), and reporting qualitative data including verbatim quotes. An adapted Critical Appraisal Skill Programme (CASP) checklist for qualitative research was used to assess paper quality. The results section of each included article was coded line by line, and all papers underwent inductive analysis, involving comparison, reexamination, and grouping of codes to develop descriptive themes. Analytical themes were developed through an iterative process of reflection on, and interpretation of, the descriptive themes within and across studies. RESULTS: Across the 22 included papers, 3 analytical themes emerged, each with 3 descriptive subthemes: (1) influence of telehealth on the disrupted lives of cancer survivors (convenience, independence, and burden); (2) personalized care across physical distance (time, space, and the human factor); and (3) remote reassurance-a safety net of health care professional connection (active connection, passive connection, and slipping through the net). Telehealth interventions represent a convenient approach, which can potentially minimize treatment burden and disruption to cancer survivors' lives. Telehealth interventions can facilitate an experience of personalized care and reassurance for those

living with and beyond cancer; however, it is important to consider individual factors when tailoring interventions to ensure engagement promotes benefit rather than burden.

CONCLUSIONS: Telehealth interventions can provide cancer survivors with independence and reassurance. Future telehealth interventions need to be developed iteratively in collaboration with a broad range of cancer survivors to maximize engagement and benefit.

de la Torre Diez, I., Alonso, S. G., Hamrioui, S., et al. (2018). "Systematic Review about QoS and QoE in Telemedicine and eHealth Services and Applications." *J Med Syst* **42**(10): 182.

The provision of Quality of Service (QoS) and Quality of Experience (QoE) is a mandatory requirement when transmitting telemedicine traffic, due to information relevance to maintain the patient's health. The main objective of this paper is to present a review of existing research works in the literature, referring to QoS and QoE in telemedicine and eHealth applications. The academic databases that were used to perform the searches are Google Scholar, IEEE Xplore, PubMed, Science Direct and Web of Science, taking into account the date of publication from 2008 to the present. These databases cover the most information of scientific texts in multidisciplinary fields, engineering and medicine. Several search criteria were established such as 'QoS' AND 'eHealth' OR 'Telemedicine', 'QoE' AND 'eHealth' AND 'Telemedicine' etc. selecting the items of greatest interest. A total of 248 papers related to QoS and QoE in telemedicine and eHealth have been found, of which 39 papers have been identified as relevant works. The results show that the percentage of studies related to QoS in literature is higher with 74.36% to QoE with 25.64%. From the review of the research articles analyzed, it can be said that QoS and QoE in telemedicine and eHealth are important and necessary factors to guarantee the privacy, reliability, quality and security of data in health care systems.

de Waure, C., Cadeddu, C., Gualano, M. R., et al. (2012). "Telemedicine for the reduction of myocardial infarction mortality: a systematic review and a meta-analysis of published studies." *Telemed J E Health* **18**(5): 323-328.

INTRODUCTION: Advances in electronics and communications have changed modern medicine: telemedicine allows patient assessment and monitoring to facilitate healthcare at a distance. The aim of this study was to perform a systematic review and meta-analysis to assess how telemedicine systems, including early telemetry of electrocardiograms, can improve health outcomes in patients with coronary artery disease and, in particular, acute myocardial infarction (AMI). METHODS: Studies dealing with telemedicine applications in managing AMI that were conducted before January 22, 2010, published in English or Italian, were identified in PubMed and ISI Web of Knowledge searches. The meta-analysis was performed to assess the efficacy of telemedicine versus standard measures in reducing mortality. Relative risk (RR) with 95% confidence interval was used to report results and the I(2) test to evaluate heterogeneity. RESULTS: Five of the 39 articles retrieved were selected; all studies demonstrated the efficacy of telemedicine applications. Only three studies were judged to be comparable and suitable for combining data. This meta-analysis showed that the RR for in-hospital mortality from AMI was 0.65 (95% confidence interval, 0.42-0.99) for the telemedicine group, without heterogeneity. CONCLUSIONS: Telemedicine may improve health outcomes of patients with AMI. However, heterogeneity in study design and end points of most studies limited the number of articles that could be subjected to our meta-analysis.

Doyen, C. M., Oreve, M. J., Desailly, E., et al. (2018). "Telepsychiatry for Children and Adolescents: A Review of the PROMETTED Project." *Telemed J E Health* **24**(1): 3-10.

BACKGROUND: Telemedicine for children and adolescents is a public health topic, and since 2009 in France, the legal framework defines practical modalities. Some children with Attention Deficit with or without Hyperactivity Disorder, social anxiety, or Autism Spectrum Disorder (ASD) can be easily engaged within a teleconsultation model. Literature suggests new opportunities to facilitate the care process for the ASD person and his family: diagnosis with the use of validated instruments and parental accompaniment. **METHODS:** Since 2015, a pilot project called PROMETTED was supported by the Regional Health Agency of Ile de France. It was developed and managed by the team of the Center for Diagnosis and Evaluation for Autism (CDEA) of Sainte-Anne Hospital and associated PEDIATED, the CDEA of Versailles. **RESULTS:** Five medico-social structures for children and adolescents with ASD and the two CDEAs co-elaborated a scheme of intervention with telemedicine. The remote evaluation is a four-step process structured around the medical history and the observation of the young subject; the Autism Diagnostic Interview; the use of the Childhood Autism Rating Scale and the Vineland Adaptive Behavior Scales; and feedback to parents. **CONCLUSIONS:** Medico-economic and satisfaction evaluations are in progress.

Emami, E., Kadoch, N., Homayounfar, S., et al. (2017). "Patient satisfaction with E-Oral Health care in rural and remote settings: a systematic review protocol." *Syst Rev* **6**(1): 174.

BACKGROUND: Individuals living in rural and remote settings face oral health problems and access-to-care barriers due to the shortage of oral health care providers in these areas, geographic remoteness, lack of appropriate infrastructure and lower socio-economic status. E-Oral Health technology could mitigate these barriers by providing the delivery of some aspects of health care and exchange of information across geographic distances. This review will systematically evaluate the literature on patient satisfaction with received E-Oral Health care in rural and remote communities. **METHODS:** This systematic review will include interventional and observational studies in which E-Oral Health technology is used as an intervention in rural and remote communities of any country worldwide. Conventional oral health care will be used as a comparator when provided. Patient satisfaction with received E-Oral Health care will be considered as a primary outcome for this review. Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE and Global Health will be searched using a comprehensive search strategy. Two review authors will independently screen results to identify potentially eligible studies and independently extract the data from the included studies. A third author will resolve any discrepancies between reviewers. Two independent researchers will assess the risk of bias and the Grading of Recommendations Assessment, Development, and Evaluation. **DISCUSSION:** The potential implications and benefits of E-Oral Health care can inform policymakers and health care professionals to take advantage of this technology to address health care challenges in these areas. **SYSTEMATIC REVIEW REGISTRATION:** PROSPERO CRD42016039942 .

Feltner, C., Jones, C. D., Cene, C. W., et al. (2014). "Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis." *Ann Intern Med* **160**(11): 774-784.

BACKGROUND: Nearly 25% of patients hospitalized with heart failure (HF) are readmitted within 30 days. **PURPOSE:** To assess the efficacy, comparative effectiveness, and harms of transitional care interventions to reduce readmission and mortality rates for adults hospitalized with HF. **DATA SOURCES:** MEDLINE, Cochrane Library, CINAHL, ClinicalTrials.gov, and World Health Organization International Clinical Trials Registry Platform (1 January 1990 to late October 2013). **STUDY SELECTION:** Two reviewers independently selected randomized, controlled trials published in English reporting a readmission or mortality rate within 6 months of an index hospitalization. **DATA EXTRACTION:** One reviewer extracted

data, and another checked accuracy. Two reviewers assessed risk of bias and graded strength of evidence (SOE). DATA SYNTHESIS: Forty-seven trials were included. Most enrolled adults with moderate to severe HF and a mean age of 70 years. Few trials reported 30-day readmission rates. At 30 days, a high-intensity home-visiting program reduced all-cause readmission and the composite end point (all-cause readmission or death; low SOE). Over 3 to 6 months, home-visiting programs and multidisciplinary heart failure (MDS-HF) clinic interventions reduced all-cause readmission (high SOE). Home-visiting programs reduced HF-specific readmission and the composite end point (moderate SOE). Structured telephone support (STS) interventions reduced HF-specific readmission (high SOE) but not all-cause readmissions (moderate SOE). Home-visiting programs, MDS-HF clinics, and STS interventions produced a mortality benefit. Neither telemonitoring nor primarily educational interventions reduced readmission or mortality rates. LIMITATIONS: Few trials reported 30-day readmission rates. Usual care was heterogeneous and sometimes not adequately described. CONCLUSION: Home-visiting programs and MDS-HF clinics reduced all-cause readmission and mortality; STS reduced HF-specific readmission and mortality. These interventions should receive the greatest consideration by systems or providers seeking to implement transitional care interventions for persons with HF. PRIMARY FUNDING SOURCE: Agency for Healthcare Research and Quality.

Fiorino, G., Allocca, M., Chaparro, M., et al. (2019). "Quality of Care' Standards in Inflammatory Bowel Disease: A Systematic Review." *J Crohns Colitis* **13**(1): 127-137.

Background: Inflammatory bowel disease [IBD] includes chronic, disabling and progressive conditions that need a complex approach and management. Although several attempts have been made to standardize the care of IBD patients, no clear definitions of a global 'standard of care' are currently available. Methods: We performed a systematic review of the available literature, searching for all relevant data concerning three main domains of standards of quality of care in IBD patients: structure, process and outcomes. From the literature search, 2394 abstracts were retrieved, and 62 relevant papers were included in the final review. Results: Standards of quality of care in IBD include several aspects that can be summarized in three identified domains: structure, process and outcomes. The suggested structure of an IBD Unit includes a multi-disciplinary approach, effective referral processes, improved access using helplines, and departmental guidelines/pathways with identification of measurable quality indicators. Coordinated care models which incorporate a multi-disciplinary approach, structured clinical pathways or processes for the diagnosis, monitoring and treatment of IBD, fast-track recovery from IBD surgery, designated IBD clinics, virtual clinics and telemanagement are currently considered the main standards for process, although supporting data are limited. Several consensus statements on outcomes and quality indicators have been reported, focusing on outcomes in symptoms, function and quality of life restoration, survival and disease control, in addition to effective healthcare utilization. Conclusions: The results of this systematic review can provide the basis for general recommendations for standards of quality of care in IBD.

Flodgren, G., Rachas, A., Farmer, A. J., et al. (2015). "Interactive telemedicine: effects on professional practice and health care outcomes." *Cochrane Database Syst Rev*(9): Cd002098.

BACKGROUND: Telemedicine (TM) is the use of telecommunication systems to deliver health care at a distance. It has the potential to improve patient health outcomes, access to health care and reduce healthcare costs. As TM applications continue to evolve it is important to understand the impact TM might have on patients, healthcare professionals and the organisation of care. OBJECTIVES: To assess the effectiveness, acceptability and costs of interactive TM as an alternative to, or in addition to, usual care (i.e. face-to-face care, or

telephone consultation). SEARCH METHODS: We searched the Effective Practice and Organisation of Care (EPOC) Group's specialised register, CENTRAL, MEDLINE, EMBASE, five other databases and two trials registers to June 2013, together with reference checking, citation searching, handsearching and contact with study authors to identify additional studies. SELECTION CRITERIA: We considered randomised controlled trials of interactive TM that involved direct patient-provider interaction and was delivered in addition to, or substituting for, usual care compared with usual care alone, to participants with any clinical condition. We excluded telephone only interventions and wholly automatic self-management TM interventions. DATA COLLECTION AND ANALYSIS: For each condition, we pooled outcome data that were sufficiently homogenous using fixed effect meta-analysis. We reported risk ratios (RR) and 95% confidence intervals (CI) for dichotomous outcomes, and mean differences (MD) for continuous outcomes. MAIN RESULTS: We included 93 eligible trials (N = 22,047 participants), which evaluated the effectiveness of interactive TM delivered in addition to (32% of studies), as an alternative to (57% of studies), or partly substituted for usual care (11%) as compared to usual care alone. The included studies recruited patients with the following clinical conditions: cardiovascular disease (36), diabetes (21), respiratory conditions (9), mental health or substance abuse conditions (7), conditions requiring a specialist consultation (6), co morbidities (3), urogenital conditions (3), neurological injuries and conditions (2), gastrointestinal conditions (2), neonatal conditions requiring specialist care (2), solid organ transplantation (1), and cancer (1). Telemedicine provided remote monitoring (55 studies), or real-time video-conferencing (38 studies), which was used either alone or in combination. The main TM function varied depending on clinical condition, but fell typically into one of the following six categories, with some overlap: i) monitoring of a chronic condition to detect early signs of deterioration and prompt treatment and advice, (41); ii) provision of treatment or rehabilitation (12), for example the delivery of cognitive behavioural therapy, or incontinence training; iii) education and advice for self-management (23), for example nurses delivering education to patients with diabetes or providing support to parents of very low birth weight infants or to patients with home parenteral nutrition; iv) specialist consultations for diagnosis and treatment decisions (8), v) real-time assessment of clinical status, for example post-operative assessment after minor operation or follow-up after solid organ transplantation (8) vi), screening, for angina (1). The type of data transmitted by the patient, the frequency of data transfer, (e.g. telephone, e-mail, SMS) and frequency of interactions between patient and healthcare provider varied across studies, as did the type of healthcare provider/s and healthcare system involved in delivering the intervention. We found no difference between groups for all-cause mortality for patients with heart failure (16 studies; N = 5239; RR:0.89, 95% CI 0.76 to 1.03, P = 0.12; I(2) = 44%) (moderate to high certainty of evidence) at a median of six months follow-up. Admissions to hospital (11 studies; N = 4529) ranged from a decrease of 64% to an increase of 60% at median eight months follow-up (moderate certainty of evidence). We found some evidence of improved quality of life (five studies; N = 482; MD:-4.39, 95% CI -7.94 to -0.83; P < 0.02; I(2) = 0%) (moderate certainty of evidence) for those allocated to TM as compared with usual care at a median three months follow-up. In studies recruiting participants with diabetes (16 studies; N = 2768) we found lower glycated haemoglobin (HbA1c %) levels in those allocated to TM than in controls (MD -0.31, 95% CI -0.37 to -0.24; P < 0.00001; I(2)= 42%, P = 0.04) (high certainty of evidence) at a median of nine months follow-up. We found some evidence for a decrease in LDL (four studies, N = 1692; MD -12.45, 95% CI -14.23 to -10.68; P < 0.00001; I(2) = 0%) (moderate certainty of evidence), and blood pressure (four studies, N = 1770: MD: SBP:-4.33, 95% CI -5.30 to -3.35, P < 0.00001; I(2) = 17%; DBP: -2.75 95% CI -3.28 to -2.22, P < 0.00001; I(2) = 45% (moderate certainty evidence), in TM as compared with usual care. Seven studies that recruited participants with different mental health and substance abuse problems, reported no differences in the effect of therapy delivered over video-conferencing, as compared to face-to-face delivery. Findings from the

other studies were inconsistent; there was some evidence that monitoring via TM improved blood pressure control in participants with hypertension, and a few studies reported improved symptom scores for those with a respiratory condition. Studies recruiting participants requiring mental health services and those requiring specialist consultation for a dermatological condition reported no differences between groups. AUTHORS' CONCLUSIONS: The findings in our review indicate that the use of TM in the management of heart failure appears to lead to similar health outcomes as face-to-face or telephone delivery of care; there is evidence that TM can improve the control of blood glucose in those with diabetes. The cost to a health service, and acceptability by patients and healthcare professionals, is not clear due to limited data reported for these outcomes. The effectiveness of TM may depend on a number of different factors, including those related to the study population e.g. the severity of the condition and the disease trajectory of the participants, the function of the intervention e.g., if it is used for monitoring a chronic condition, or to provide access to diagnostic services, as well as the healthcare provider and healthcare system involved in delivering the intervention.

Greenhalgh, T., A'Court, C. et Shaw, S. (2017). "Understanding heart failure; explaining telehealth - a hermeneutic systematic review." *BMC Cardiovasc Disord* **17**(1): 156.

BACKGROUND: Enthusiasts for telehealth extol its potential for supporting heart failure management. But randomised trials have been slow to recruit and produced conflicting findings; real-world roll-out has been slow. We sought to inform policy by making sense of a complex literature on heart failure and its remote management. METHODS: Through database searching and citation tracking, we identified 7 systematic reviews of systematic reviews, 32 systematic reviews (including 17 meta-analyses and 8 qualitative reviews); six mega-trials and over 60 additional relevant empirical studies and commentaries. We synthesised these using Boell's hermeneutic methodology for systematic review, which emphasises the quest for understanding. RESULTS: Heart failure is a complex and serious condition with frequent co-morbidity and diverse manifestations including severe tiredness. Patients are often frightened, bewildered, socially isolated and variably able to self-manage. Remote monitoring technologies are many and varied; they create new forms of knowledge and new possibilities for care but require fundamental changes to clinical roles and service models and place substantial burdens on patients, carers and staff. The policy innovation of remote biomarker monitoring enabling timely adjustment of medication, mediated by "activated" patients, is based on a modernist vision of efficient, rational, technology-mediated and guideline-driven ("cold") care. It contrasts with relationship-based ("warm") care valued by some clinicians and by patients who are older, sicker and less technically savvy. Limited uptake of telehealth can be analysed in terms of key tensions: between tidy, "textbook" heart failure and the reality of multiple comorbidities; between basic and intensive telehealth; between activated, well-supported patients and vulnerable, unsupported ones; between "cold" and "warm" telehealth; and between fixed and agile care programmes. CONCLUSION: The limited adoption of telehealth for heart failure has complex clinical, professional and institutional causes, which are unlikely to be elucidated by adding more randomised trials of technology-on versus technology-off to an already-crowded literature. An alternative approach is proposed, based on naturalistic study designs, application of social and organisational theory, and co-design of new service models based on socio-technical principles. Conventional systematic reviews (whose goal is synthesising data) can be usefully supplemented by hermeneutic reviews (whose goal is deepening understanding).

Guisse, V., Anderson, J. et Wiig, S. (2014). "Patient safety risks associated with telecare: a systematic review and narrative synthesis of the literature." *BMC Health Serv Res* **14**: 588.

BACKGROUND: Patient safety risk in the homecare context and patient safety risk related to telecare are both emerging research areas. Patient safety issues associated with the use of telecare in homecare services are therefore not clearly understood. It is unclear what the patient safety risks are, how patient safety issues have been investigated, and what research is still needed to provide a comprehensive picture of risks, challenges and potential harm to patients due to the implementation and use of telecare services in the home. Furthermore, it is unclear how training for telecare users has addressed patient safety issues. A systematic review of the literature was conducted to identify patient safety risks associated with telecare use in homecare services and to investigate whether and how these patient safety risks have been addressed in telecare training. **METHODS:** Six electronic databases were searched in addition to hand searches of key items, reference tracking and citation tracking. Strict inclusion and exclusion criteria were set. All included items were assessed according to set quality criteria and subjected to a narrative synthesis to organise and synthesize the findings. A human factors systems framework of patient safety was used to frame and analyse the results. **RESULTS:** 22 items were included in the review. 11 types of patient safety risks associated with telecare use in homecare services emerged. These are in the main related to the nature of homecare tasks and practices, and person-centred characteristics and capabilities, and to a lesser extent, problems with the technology and devices, organisational issues, and environmental factors. Training initiatives related to safe telecare use are not described in the literature. **CONCLUSIONS:** There is a need to better identify and describe patient safety risks related to telecare services to improve understandings of how to avoid and minimize potential harm to patients. This process can be aided by reframing known telecare implementation challenges and user experiences of telecare with the help of a human factors systems approach to patient safety.

HAS (2019). Évaluer les dispositifs médicaux connectés, y compris ceux faisant appel à l'intelligence artificielle. Saint-Senis HAS: 2 vol. (20 +70).

https://www.has-sante.fr/portail/jcms/c_2905546/fr/evaluer-les-dispositifs-medicaux-connectes-y-compris-ceux-faisant-appel-a-l-intelligence-artificielle?cid=fc_1249599, https://www.has-sante.fr/portail/jcms/c_2845863/fr/specificites-methodologiques-d-evaluation-clinique-des-dispositifs-medicaux-connectes

Ce guide précise les spécificités de l'évaluation clinique à l'attention des industriels qui sollicitent leur remboursement. Si l'évaluation repose sur les mêmes critères que pour tout autre type de dispositif médical, des spécificités liées à leur caractère connecté doivent être prises en compte : rapidité d'évolution de la solution technologique, interactions multiples entre patients, aidants, soignants et autres dispositifs médicaux ou objets, intégration de systèmes experts traitant les données (algorithmes avec ou sans intelligence artificielle).

Huibers, L., Smits, M., Renaud, V., et al. (2011). "Safety of telephone triage in out-of-hours care: a systematic review." *Scand J Prim Health Care* **29**(4): 198-209.

OBJECTIVE: Telephone triage in patients requesting help may compromise patient safety, particularly if urgency is underestimated and the patient is not seen by a physician. The aim was to assess the research evidence on safety of telephone triage in out-of-hours primary care. **METHODS:** A systematic review was performed of published research on telephone triage in out-of-hours care, searching in PubMed and EMBASE up to March 2010. Studies were included if they concerned out-of-hours medical care and focused on telephone triage in patients with a first request for help. Study inclusion and data extraction were performed by two researchers independently. Post-hoc two types of studies were distinguished: observational studies in contacts with real patients (unselected and highly urgent contacts),

and prospective observational studies using high-risk simulated patients (with a highly urgent health problem). RESULTS: Thirteen observational studies showed that on average triage was safe in 97% (95% CI 96.5-97.4%) of all patients contacting out-of-hours care and in 89% (95% CI 86.7-90.2%) of patients with high urgency. Ten studies that used high-risk simulated patients showed that on average 46% (95% CI 42.7-49.8%) were safe. Adverse events described in the studies included mortality (n = 6 studies), hospitalisations (n = 5), attendance at emergency department (n=1), and medical errors (n = 6). CONCLUSIONS: There is room for improvement in safety of telephone triage in patients who present symptoms that are high risk. As these have a low incidence, recognition of these calls poses a challenge to health care providers in daily practice.

Iribarren, S. J., Brown, W., 3rd, Giguere, R., et al. (2017). "Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions." *Int J Med Inform* **101**: 28-40.

OBJECTIVES: Mobile technology supporting text messaging interventions (TMIs) continues to evolve, presenting challenges for researchers and healthcare professionals who need to choose software solutions to best meet their program needs. The objective of this review was to systematically identify and compare text messaging platforms and to summarize their advantages and disadvantages as described in peer-reviewed literature. METHODS: A scoping review was conducted using four steps: 1) identify currently available platforms through online searches and in mHealth repositories; 2) expand evaluation criteria of an mHealth mobile messaging toolkit and integrate prior user experiences as researchers; 3) evaluate each platform's functions and features based on the expanded criteria and a vendor survey; and 4) assess the documentation of platform use in the peer-review literature. Platforms meeting inclusion criteria were assessed independently by three reviewers and discussed until consensus was reached. The PRISMA guidelines were followed to report findings. RESULTS: Of the 1041 potentially relevant search results, 27 platforms met inclusion criteria. Most were excluded because they were not platforms (e.g., guides, toolkits, reports, or SMS gateways). Of the 27 platforms, only 12 were identified in existing mHealth repositories, 10 from Google searches, while five were found in both. The expanded evaluation criteria included 22 items. Results indicate no uniform presentation of platform features and functions, often making these difficult to discern. Fourteen of the platforms were reported as open source, 10 focused on health care and 16 were tailored to meet needs of low resource settings (not mutually exclusive). Fifteen platforms had do-it-yourself setup (programming not required) while the remainder required coding/programming skills or setups could be built to specification by the vendor. Frequently described features included data security and access to the platform via cloud-based systems. Pay structures and reported targeted end-users varied. Peer-reviewed publications listed only 6 of the 27 platforms across 21 publications. The majority of these articles reported the name of the platform used but did not describe advantages or disadvantages. CONCLUSIONS: Searching for and comparing mHealth platforms for TMIs remains a challenge. The results of this review can serve as a resource for researchers and healthcare professionals wanting to integrate TMIs into health interventions. Steps to identify, compare and assess advantages and disadvantages are outlined for consideration. Expanded evaluation criteria can be used by future researchers. Continued and more comprehensive platform tools should be integrated into mHealth repositories. Detailed descriptions of platform advantages and disadvantages are needed when mHealth researchers publish findings to expand the body of research on TMI tools for healthcare. Standardized descriptions and features are recommended for vendor sites.

Keane, M. G. (2009). "A review of the role of telemedicine in the accident and emergency department." *J Telemed Telecare* **15**(3): 132-134.

A literature search was conducted for articles on the role of telemedicine in accident and emergency work. The search yielded 39 relevant papers, which came from 21 independent groups that had used telemedicine in an emergency medicine setting. The articles showed that telemedicine has been applied in a variety of ways from medical advice for paramedics in the disaster setting, to patient follow-up in the fracture clinic. A variety of communications equipment has been tried, including radio links, telephone, email and mobile wireless videoconferencing devices. All such links have been found to transfer information effectively, but success has sometimes been limited by technical failure and by staff lacking confidence in using the systems. Telemedicine has been used widely to support emergency nurse practitioners in minor injury units. Telemedicine has also been suggested as a way for paramedics to communicate with regional coronary care units quickly, hence enabling them to provide pre-hospital thrombolysis in the field when appropriate. The accident and emergency setting is well suited to the application of telemedicine. Larger trials and cost-effectiveness studies are required in this area.

Kidholm, K., Clemensen, J., Caffery, L. J., et al. (2017). "The Model for Assessment of Telemedicine (MAST): A scoping review of empirical studies." *J Telemed Telecare* **23**(9): 803-813.

The evaluation of telemedicine can be achieved using different evaluation models or theoretical frameworks. This paper presents a scoping review of published studies which have applied the Model for Assessment of Telemedicine (MAST). MAST includes pre-implementation assessment (e.g. by use of participatory design), followed by multidisciplinary assessment, including description of the patients and the application and assessment of safety, clinical effectiveness, patient perspectives, economic aspects organisational aspects and socio-cultural, legal and ethical aspects. Twenty-two studies met the inclusion criteria and were included in the review. In this article, research design and methods used in the multidisciplinary assessment are described, strengths and weaknesses are analysed, and recommendations for future research are presented.

Kotb, A., Cameron, C., Hsieh, S., et al. (2015). "Comparative effectiveness of different forms of telemedicine for individuals with heart failure (HF): a systematic review and network meta-analysis." *PLoS One* **10**(2): e0118681.

BACKGROUND: Previous studies on telemedicine have either focused on its role in the management of chronic diseases in general or examined its effectiveness in comparison to standard post-discharge care. Little has been done to determine the comparative impact of different telemedicine options for a specific population such as individuals with heart failure (HF). **METHODS AND FINDINGS:** Systematic reviews (SR) of randomized controlled trials (RCTs) that examined telephone support, telemonitoring, video monitoring or electrocardiographic monitoring for HF patients were identified using a comprehensive search of the following databases: MEDLINE, EMBASE, CINAHL and The Cochrane Library. Studies were included if they reported the primary outcome of mortality or any of the following secondary outcomes: all-cause hospitalization and heart failure hospitalization. Thirty RCTs (N = 10,193 patients) were included. Compared to usual care, structured telephone support was found to reduce the odds of mortality (Odds Ratio 0.80; 95% Credible Intervals [0.66 to 0.96]) and hospitalizations due to heart failure (0.69; [0.56 to 0.85]). Telemonitoring was also found to reduce the odds of mortality (0.53; [0.36 to 0.80]) and reduce hospitalizations related to heart failure (0.64; [0.39 to 0.95]) compared to usual post-discharge care. Interventions that involved ECG monitoring also reduced the odds of hospitalization due to heart failure (0.71; [0.52 to 0.98]). **LIMITATIONS:** Much of the evidence currently available has focused on the comparing either telephone support or telemonitoring with usual care. This has therefore limited our current understanding of how some of the less

common forms of telemedicine compare to one another. CONCLUSIONS: Compared to usual care, structured telephone support and telemonitoring significantly reduced the odds of deaths and hospitalization due to heart failure. Despite being the most widely studied forms of telemedicine, little has been done to directly compare these two interventions against one another. Further research into their comparative cost-effectiveness is also warranted.

Kruse, C. S., Krowski, N., Rodriguez, B., et al. (2017). "Telehealth and patient satisfaction: a systematic review and narrative analysis." *BMJ Open* **7**(8): e016242.

BACKGROUND: The use of telehealth steadily increases as it has become a viable modality to patient care. Early adopters attempt to use telehealth to deliver high-quality care. Patient satisfaction is a key indicator of how well the telemedicine modality met patient expectations. OBJECTIVE: The objective of this systematic review and narrative analysis is to explore the association of telehealth and patient satisfaction in regards to effectiveness and efficiency. METHODS: Boolean expressions between keywords created a complex search string. Variations of this string were used in Cumulative Index of Nursing and Allied Health Literature and MEDLINE. RESULTS: 2193 articles were filtered and assessed for suitability (n=44). Factors relating to effectiveness and efficiency were identified using consensus. The factors listed most often were improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost (8%), improved communication (8%) and decreased travel time (7%), which in total accounted for 61% of occurrences. CONCLUSION: This review identified a variety of factors of association between telehealth and patient satisfaction. Knowledge of these factors could help implementers to match interventions as solutions to specific problems.

Lin, M. H., Yuan, W. L., Huang, T. C., et al. (2017). "Clinical effectiveness of telemedicine for chronic heart failure: a systematic review and meta-analysis." *J Investig Med* **65**(5): 899-911.

Telemedicine interventions may be associated with reductions in hospital admission rate and mortality in patients with heart failure (HF). The present study is an updated analysis (as of June 30, 2016) of randomized controlled trials, where patients with HF underwent telemedicine care or the usual standard care. Data were extracted from 39 eligible studies for all-cause and HF-related hospital admission rate, length of stay, and mortality. The overall all-cause mortality (pooled OR=0.80, 95% CI 0.71 to 0.91, p<0.001), HF-related admission rate (pooled OR=0.63, 95% CI 0.53 to 0.76, p<0.001), and HF-related length of stay (pooled standardized difference in means=-0.37, 95% CI -0.72 to -0.02, p=0.041) were significantly lower in the telemedicine group (teletransmission and telephone-supported care), as compared with the control group. In subgroup analysis, all-cause mortality (pooled OR=0.69, 95% CI 0.56 to 0.86, p=0.001), HF-related admission rate (OR=0.61, 95% CI 0.42 to 0.88, p=0.008), HF-related length of stay (pooled standardized difference in means=-0.96, 95% CI -1.88 to -0.05, p=0.039) and HF-related mortality (OR=0.68, 95% CI 0.54 to 0.85, p=0.001) were significantly lower in the teletransmission group, as opposed to the standard care group, whereas only HF-related admission rate (OR=0.64, 95% CI 0.52 to 0.79, p<0.001) was lower in the telephone-supported care group. Overall, telemedicine was shown to be beneficial, with home-based teletransmission effectively reducing all-cause mortality and HF-related hospital admission, length of stay and mortality in patients with HF.

Linn, A. J., Vervloet, M., van Dijk, L., et al. (2011). "Effects of eHealth interventions on medication adherence: a systematic review of the literature." *J Med Internet Res* **13**(4): e103.

BACKGROUND: Since medication nonadherence is considered to be an important health risk, numerous interventions to improve adherence have been developed. During the past

decade, the use of Internet-based interventions to improve medication adherence has increased rapidly. Internet interventions have the potential advantage of tailoring the interventions to the needs and situation of the patient. OBJECTIVE: The main aim of this systematic review was to investigate which tailored Internet interventions are effective in improving medication adherence. METHODS: We undertook comprehensive literature searches in PubMed, PsycINFO, EMBASE, CINAHL, and Communication Abstracts, following the guidelines of the Cochrane Collaboration. The methodological quality of the randomized controlled trials and clinical controlled trials and methods for measuring adherence were independently reviewed by two researchers. RESULTS: A total of 13 studies met the inclusion criteria. All included Internet interventions clearly used moderately or highly sophisticated computer-tailored methods. Data synthesis revealed that there is evidence for the effectiveness of Internet interventions in improving medication adherence: 5 studies (3 high-quality studies and 2 low-quality studies) showed a significant effect on adherence; 6 other studies (4 high-quality studies and 2 low-quality studies) reported a moderate effect on adherence; and 2 studies (1 high-quality study and 1 low-quality study) showed no effect on patients' adherence. However, most studies used self-reported measurements to assess adherence, which is generally perceived as a low-quality measurement. In addition, we did not find a clear relationship between the quality of the studies or the level of sophistication of message tailoring and the effectiveness of the intervention. This might be explained by the great difference in study designs and the way of measuring adherence, which makes results difficult to compare. There was also large variation in the measured interval between baseline and follow-up measurements. CONCLUSION: This review shows promising results on the effectiveness of Internet interventions to enhance patients' adherence to prescribed long-term medications. Although there is evidence according to the data synthesis, the results must be interpreted with caution due to low-quality adherence measurements. Future studies using high-quality measurements to assess medication adherence are recommended to establish more robust evidence for the effectiveness of eHealth interventions on medication adherence.

Ludwig, W., Wolf, K. H., Duwenkamp, C., et al. (2012). "Health-enabling technologies for the elderly--an overview of services based on a literature review." Comput Methods Programs Biomed **106**(2): 70-78.

BACKGROUND: Services for the elderly based on health-enabling technologies promise to contribute significantly to the efficiency and effectiveness of future health care. Due to this promise, over the last years the scientific community has designed a complex variety of these valuable innovations. A systematic overview of the developed services would help to better understand their opportunities and limitations. OBJECTIVE: To obtain a systematic overview of services for the elderly based on health-enabling technologies and to identify archetypical service categories. METHODS: We conducted a literature review using PubMed and retrieved 1447 publications. We stepwise reduced this list to 27 key publications that describe typical service archetypes. RESULTS: We present six archetypical service categories, namely handling adverse conditions, assessing state of health, consultation and education, motivation and feedback, service ordering and social inclusion and describe their implementation in current research projects.

Mair, F. et Whitten, P. (2000). "Systematic review of studies of patient satisfaction with telemedicine." British Medical Journal **320**: 1517-1520, 1511 tabl.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC27397/pdf/1517.pdf>

Massoudi, B., Holvast, F., Bockting, C. L. H., et al. (2019). "The effectiveness and cost-effectiveness of e-health interventions for depression and anxiety in primary care: A systematic review and meta-analysis." *J Affect Disord* **245**: 728-743.

PURPOSE: Psychological interventions are labor-intensive and expensive, but e-health interventions may support them in primary care. In this study, we systematically reviewed the effectiveness and cost-effectiveness of e-health interventions for depressive and anxiety symptoms and disorders in primary care. **METHODS:** We searched MEDLINE, Cochrane library, Embase, and PsychINFO until January 2018, for randomized controlled trials of e-health interventions for depression or anxiety in primary care. Two reviewers independently screened the identified publications, extracted data, and assessed risk of bias using the Cochrane Collaboration's tool. **RESULTS:** Out of 3617 publications, we included 14 that compared 33 treatments in 4183 participants. Overall, the methodological quality was poor to fair. The pooled effect size of e-health interventions was small (standardized mean difference=-0.19, 95%CI -0.31 to -0.06) for depression compared to control groups in the short-term, but this was maintained in the long-term (standardized mean difference=-0.22, 95%CI -0.35 to -0.09). Further analysis showed that e-health for depression had a small effect compared to care as usual and a moderate effect compared to waiting lists. One trial on anxiety showed no significant results. Four trials reported on cost-effectiveness. **LIMITATIONS:** The trials studied different types of e-health interventions and had several risks of bias. Moreover, only one study was included for anxiety. **CONCLUSIONS:** E-health interventions for depression have a small effect in primary care, with a moderate effect compared to waiting lists. The approach also appeared to be cost-effective for depression. However, we found no evidence for its effectiveness for anxiety.

Moshi, M. R., Tooher, R. et Merlin, T. (2018). "SUITABILITY OF CURRENT EVALUATION FRAMEWORKS FOR USE IN THE HEALTH TECHNOLOGY ASSESSMENT OF MOBILE MEDICAL APPLICATIONS: A SYSTEMATIC REVIEW." *Int J Technol Assess Health Care* **34**(5): 464-475.

OBJECTIVES: To identify and appraise existing evaluation frameworks for mobile medical applications (MMA) and determine their suitability for use in health technology assessment (HTA) of these technologies. **METHODS:** Systematic searches were conducted of seven bibliographic databases to identify literature published between 2008 and 2016 on MMA evaluation frameworks. Frameworks were eligible if they were used to evaluate at least one of the HTA domains of effectiveness, safety, and/or cost and cost-effectiveness of an MMA. After inclusion, the frameworks were reviewed to determine the number and extent to which other elements of an HTA were addressed by the framework. **RESULTS:** A total of forty-five frameworks were identified that assessed MMAs. All frameworks assessed whether the app was effective. Of the thirty-four frameworks that examined safety, only seven overtly evaluated potential harms from the MMA (e.g., the impact of inaccurate information). Only one framework explicitly considered a comparator. Technology specific domains were sporadically addressed. **CONCLUSION:** None of the evaluation frameworks could be used, unaltered, to guide the HTA of MMAs. To use these frameworks in HTA they would need to identify relevant comparators, improve assessments of harms and consider the ongoing effect of software updates on the safety and effectiveness of MMAs. Attention should also be paid to ethical issues, such as data privacy, and technology specific characteristics. **IMPLICATIONS:** Existing MMA evaluation frameworks are not suitable for use in HTA. Further research is needed before an MMA evaluation framework can be developed that will adequately inform policy makers.

Norwood, C., Moghaddam, N. G., Malins, S., et al. (2018). "Working alliance and outcome effectiveness in videoconferencing psychotherapy: A systematic review and noninferiority meta-analysis." *Clin Psychol Psychother* **25**(6): 797-808.

Videoconferencing psychotherapy (VCP)-the remote delivery of psychotherapy via secure video link-is an innovative way of delivering psychotherapy, which has the potential to overcome many of the regularly cited barriers to accessing psychological treatment. However, some debate exists as to whether an adequate working alliance can be formed between therapist and client, when therapy is delivered through such a medium. The presented article is a systematic literature review and two meta-analyses aimed at answering the questions: Is working alliance actually poorer in VCP? And is outcome equivalence possible between VCP and face-to-face delivery? Twelve studies were identified which met inclusion/exclusion criteria, all of which demonstrated good working alliance and outcome for VCP. Meta-analyses showed that working alliance in VCP was inferior to face-to-face delivery (standardized mean difference [SMD] = -0.30; 95% confidence interval [CI] [-0.67, 0.07], $p = 0.11$; with the lower bound of the CI extending beyond the noninferiority margin [-0.50]), but that target symptom reduction was noninferior (SMD = -0.03; 95% CI [-0.45, 0.40], $p = 0.90$; CI within the noninferiority margin [0.50]). These results are discussed and directions for future research recommended.

Purnomo, J., Coote, K., Mao, L., et al. (2018). "Using eHealth to engage and retain priority populations in the HIV treatment and care cascade in the Asia-Pacific region: a systematic review of literature." *BMC Infect Dis* **18**(1): 82.

BACKGROUND: The exponential growth in the reach and development of new technologies over the past decade means that mobile technologies and social media play an increasingly important role in service delivery models to maximise HIV testing and access to treatment and care. This systematic review examines the impact of electronic and mobile technologies in medical care (eHealth) in the linkage to and retention of priority populations in the HIV treatment and care cascade, focussing on the Asia-Pacific region. **METHODS:** The review was informed by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement from the Cochrane Collaboration guidelines. Both grey and published scientific literature from five different databases were searched for all original articles in English published from 2010 to 2017. Studies conducted outside the Asia-Pacific region or not including HIV priority populations were excluded. The methodological quality of studies included in the review was assessed using the Quality Assessment Tool for Quantitative Studies. **RESULTS:** The database search identified 7309 records. Of the 224 peer-reviewed articles identified for full text review, 16 studies from seven countries met inclusion criteria. Six cross sectional studies found evidence to support the use of eHealth, via text messages, instant messaging, social media and health promotion websites, to increase rates of HIV testing and re-testing among men who have sex with men (MSM). Evidence regarding the efficacy of eHealth interventions to improve antiretroviral treatment (ART) adherence was mixed, where one randomised controlled trial (RCT) showed significant benefit of weekly phone call reminders on improving ART adherence. Three further RCTs found that biofeedback eHealth interventions that provided estimated ART plasma concentration levels, showed promising results for ART adherence. **CONCLUSIONS:** This review found encouraging evidence about how eHealth can be used across the HIV treatment and care cascade in the Asia-Pacific region, including increasing HIV testing and re-testing in priority populations as well as ART adherence. eHealth interventions have an important role to play in the movement towards the end of AIDS, particularly to target harder-to-reach HIV priority populations, such as MSM.

Rasekaba, T. M., Furler, J., Blackberry, I., et al. (2015). "Telemedicine interventions for gestational diabetes mellitus: A systematic review and meta-analysis." *Diabetes Res Clin Pract* **110**(1): 1-9.

OBJECTIVE: To evaluate the effect of telemedicine on GDM service and maternal, and foetal outcomes. **METHODS:** A systematic review and meta-analysis of randomised controlled trials (RCT) of telemedicine interventions for GDM was conducted. We searched English publications from 01/01/1990 to 31/08/2013, with further new publication tracking to June 2015 on MEDLINE, EMBASE, PUBMED, CINAHL, the Cochrane Central Register of Controlled Trials and the World Health Organization International Clinical Trials Registry electronic databases. Findings are presented as standardised mean difference (SMD) and odds ratios (OR) or narrative and quantitative description of findings where meta-analysis was not possible. **RESULTS:** Our search yielded 721 abstracts. Four met the inclusion criteria; two publications arose from the same study, resulting in three studies for review. All studies compared telemedicine to usual care. Telemedicine was associated with significantly fewer unscheduled GDM clinic visits, SMD. Quality of life, glycaemic control (HbA1c, pre and postprandial blood glucose level (BGL)), and caesarean section rate were similar between the telemedicine and usual care groups. None of the studies evaluated costs. **CONCLUSIONS:** Telemedicine has the potential to streamline GDM service utilisation without compromising maternal and foetal outcomes. Its advantage may lie in the convenience of reducing face-to-face and unscheduled consultations. Studies are limited and more trials that include cost evaluation are required.

Trnka, P., White, M. M., Renton, W. D., et al. (2015). "A retrospective review of telehealth services for children referred to a paediatric nephrologist." *BMC Nephrol* **16**: 125.

BACKGROUND: Telemedicine has emerged as an alternative mode of health care delivery over the last decade. To date, there is very limited published information in the field of telehealth and paediatric nephrology. The aim of this study was to review our experience with paediatric telenephrology in Queensland, Australia. **METHODS:** A retrospective audit of paediatric nephrology telehealth consultations to determine the nature of the telehealth activity, reasons for referral to telehealth, and to compare costs and potential savings of the telehealth service. **RESULTS:** During a ten-year period (2004 - 2013), 318 paediatric telenephrology consultations occurred for 168 patients (95 male) with the median age of 8 years (range 3 weeks to 24 years). Congenital anomalies of the kidney and urinary tract (30 %), followed by nephrotic syndrome (16 %), kidney transplant (12 %), and urinary tract infection (9 %) were the most common diagnoses. The estimated cost savings associated with telehealth were \$31,837 in 2013 (average saving of \$505 per consultation). **CONCLUSIONS:** Our study suggests that paediatric telenephrology is a viable and economic method for patient assessment and follow up. The benefits include improved access to paediatric nephrology services for patients and their families, educational opportunity for the regional medical teams, and a substantial cost saving for the health care system.

Wallace, D. L., Hussain, A., Khan, N., et al. (2012). "A systematic review of the evidence for telemedicine in burn care: with a UK perspective." *Burns* **38**(4): 465-480.

A comprehensive systematic review of telemedicine in burn care was carried out. Studies published between 1993 and 2010 were included. The main outcome measures were the level of evidence, technical feasibility, clinical feasibility, clinical management and cost effectiveness. The search strategy yielded 24 studies, none of which were randomised. There were only five studies with a control group, and in three of these the patients act as their own controls. Four studies performed quantitative cost analysis, and five more provide qualitative cost analysis. All studies demonstrate technical and clinical feasibility. If the

significant potentials of telemedicine to assist in the acute triage, management guidance and outpatient care are to be realised, then research needs to be undertaken to provide evidence for such investment.

Wilcox, M. E. et Adhikari, N. K. (2012). "The effect of telemedicine in critically ill patients: systematic review and meta-analysis." *Crit Care* **16**(4): R127.

INTRODUCTION: Telemedicine extends intensivists' reach to critically ill patients cared for by other physicians. Our objective was to evaluate the impact of telemedicine on patients' outcomes. **METHODS:** We searched electronic databases through April 2012, bibliographies of included trials, and indexes and conference proceedings in two journals (2001 to 2012). We selected controlled trials or observational studies of critically ill adults or children, examining the effects of telemedicine on mortality. Two authors independently selected studies and extracted data on outcomes (mortality and length of stay in the intensive care unit (ICU) and hospital) and methodologic quality. We used random-effects meta-analytic models unadjusted for case mix or cluster effects and quantified between-study heterogeneity by using $I(2)$ (the percentage of total variability across studies attributable to heterogeneity rather than to chance). **RESULTS:** Of 865 citations, 11 observational studies met selection criteria. Overall quality was moderate (mean score on Newcastle-Ottawa scale, 5.1/9; range, 3 to 9). Meta-analyses showed that telemedicine, compared with standard care, is associated with lower ICU mortality (risk ratio (RR) 0.79; 95% confidence interval (CI), 0.65 to 0.96; nine studies, $n = 23,526$; $I^2 = 70\%$) and hospital mortality (RR, 0.83; 95% CI, 0.73 to 0.94; nine studies, $n = 47,943$; $I(2) = 72\%$). Interventions with continuous patient-data monitoring, with or without alerts, reduced ICU mortality (RR, 0.78; 95% CI, 0.64 to 0.95; six studies, $n = 21,384$; $I(2) = 74\%$) versus those with remote intensivist consultation only (RR, 0.64; 95% CI, 0.20 to 2.07; three studies, $n = 2,142$; $I^2 = 71\%$), but effects were statistically similar (interaction $P = 0.74$). Effects were also similar in higher (RR, 0.83; 95% CI, 0.68 to 1.02) versus lower (RR, 0.69; 95% CI, 0.40 to 1.19; interaction, $P = 0.53$) quality studies. Reductions in ICU and hospital length of stay were statistically significant (weighted mean difference (telemedicine-control), -0.62 days; 95% CI, -1.21 to -0.04 days and -1.26 days; 95% CI, -2.49 to -0.03 days, respectively; $I^2 > 90\%$ for both). **CONCLUSIONS:** Telemedicine was associated with lower ICU and hospital mortality among critically ill patients, although effects varied among studies and may be overestimated in nonrandomized designs. The optimal telemedicine technology configuration and dose tailored to ICU organization and case mix remain unclear.

Wootton, R., Bahaadinbeigy, K. et Hailey, D. (2011). "Estimating travel reduction associated with the use of telemedicine by patients and healthcare professionals: proposal for quantitative synthesis in a systematic review." *BMC Health Serv Res* **11**: 185.

BACKGROUND: A major benefit offered by telemedicine is the avoidance of travel, by patients, their carers and health care professionals. Unfortunately, there is very little published information about the extent of avoided travel. We propose to undertake a systematic review of literature which reports credible data on the reductions in travel associated with the use of telemedicine. **METHOD:** The conventional approach to quantitative synthesis of the results from multiple studies is to conduct a meta analysis. However, too much heterogeneity exists between available studies to allow a meaningful meta analysis of the avoided travel when telemedicine is used across all possible settings. We propose instead to consider all credible evidence on avoided travel through telemedicine by fitting a linear model which takes into account the relevant factors in the circumstances of the studies performed. We propose the use of stepwise multiple regression to identify which factors are significant. **DISCUSSION:** Our proposed approach is illustrated by the example of

tele dermatology. In a preliminary review of the literature we found 20 studies in which the percentage of avoided travel through telemedicine could be inferred (a total of 5199 patients). The mean percentage avoided travel reported in the 12 store-and-forward studies was 43%. In the 7 real-time studies and in a single study with a hybrid technique, 70% of the patients avoided travel. A simplified model based on the modality of telemedicine employed (i.e. real-time or store and forward) explained 29% of the variance. The use of store and forward tele dermatology alone was associated with 43% of avoided travel. The increase in the proportion of patients who avoided travel (25%) when real-time telemedicine was employed was significant ($P = 0.014$). Service planners can use this information to weigh up the costs and benefits of the two approaches.

Zhai, Y. K., Zhu, W. J., Cai, Y. L., et al. (2014). "Clinical- and cost-effectiveness of telemedicine in type 2 diabetes mellitus: a systematic review and meta-analysis." *Medicine (Baltimore)* **93**(28): e312.

Emerging telemedicine programs offer potential low-cost solutions to the management of chronic disease. We sought to evaluate the clinical effectiveness and cost effectiveness of telemedicine approaches on glycemic control in patients with type 2 diabetes mellitus. Using terms related to type 2 diabetes and telemedicine, MEDLINE, Cochrane, EMBASE, and CINAHL Plus were searched to identify relevant studies published through February 28, 2014. Data from identified clinical trials were pooled according to telemedicine approach, and evaluated using conventional meta-analytical methods. We identified 47 articles, from 35 randomized controlled trials, reporting quantitative outcomes for hemoglobin A1c (HbA1c). Twelve of the 35 studies provided intervention via telephone, either in the form of a call or a text message; 19 studies tested internet-based programs, employing video-conferencing and/or informational websites; and four studies used interventions involving electronically transmitted recommendations made by clinicians in response to internet-based reporting by patients. Overall, pooled results from these studies revealed a small, but statistically significant, decrease in HbA1c following intervention, compared to conventional treatment (pooled difference in means = -0.37, 95% CI = -0.49 to -0.25, $Z = -6.08$, $P < 0.001$). Only two of the 35 studies included assessment of cost-effectiveness. These studies were disparate, both in terms of overall expense and relative cost-effectiveness. Optimization of telemedicine approaches could potentially allow for more effective self-management of disease in type 2 diabetes patients, though evidence to-date is unconvincing. Furthermore, significant publication bias was detected, suggesting that the literature should be interpreted cautiously.

Zhang, D., Wang, G., Zhu, W., et al. (2018). "Expansion Of Telestroke Services Improves Quality Of Care Provided In Super Rural Areas." *Health Aff (Millwood)* **37**(12): 2005-2013.

Telestroke is a telemedicine intervention that facilitates communication between stroke centers and lower-resourced facilities to optimize acute stroke management. Using administrative claims data, we assessed trends in telestroke use among fee-for-service Medicare beneficiaries with acute ischemic stroke and the association between providing telestroke services and intravenous tissue plasminogen activator (IV tPA) and mechanical thrombectomy use, mortality, and medical expenditures, by urban versus rural county of residence in the period 2008-15. The proportion of ischemic stroke cases receiving telestroke increased from 0.4 to 3.8 per 1,000 cases, with usage highest among younger, male, non-Hispanic white, and patients in rural or super rural areas (super rural is the bottom quartile of rural areas). Compared with patients receiving usual care, those receiving telestroke had greater IV tPA and mechanical thrombectomy use regardless of county type, while those in super rural counties had lower thirty-day all-cause mortality. Despite increased telestroke use, rural patients remained less likely than urban patients to receive IV tPA. The findings

suggest that telestroke service expansion efforts have increased, especially in rural and super rural counties, and have improved outcomes.

LES ÉTUDES FRANÇAISES

Anap (2012). La télémédecine en action : 25 projets passés à la loupe. Un éclairage pour le déploiement national. Tome 1 : les grands enseignements. Paris ANAP: 76 , fig., annexes.
http://esante.gouv.fr/sites/default/files/2012_ANAP_telemedecine.pdf

Destiné aux porteurs de projet télémédecine et aux Agences régionales de santé (ARS), ce document a pour ambition de les aider à consolider des organisations de télémédecine existantes ou à mettre en place de nouveaux projets, au travers du retour d'expérience et de la capitalisation réalisés à partir de 25 projets matures. Ces derniers sont analysés en portant une attention particulière au projet médical, aux aspects organisationnels, techniques, juridiques, financiers, aux ressources humaines, à la gouvernance, à la gestion de projet et à l'évaluation, et déclinés en fonction des priorités nationales. L'analyse met en évidence des situations très diverses, liées à la maturité des organisations. Toutefois, ce document identifie 5 facteurs clés de succès : un projet médical répondant à un besoin, un portage médical fort soutenu par un coordonnateur, une organisation adaptée et protocolisée, des nouvelles compétences à évaluer et un modèle économique construit. Le document vise également à favoriser la mise en œuvre du Plan national de déploiement de la télémédecine (résumé de l'éditeur).

CNOM (2014). Vademecum télémédecine. Paris Conseil National de l'Ordre des médecins: 21.

http://www.conseil-national.medecin.fr/sites/default/files/cn_pdf/septembre2014/master/sources/projet/MED_ECINS-Vademecum.pdf

Ce Vade-mécum constitue un guide commenté sur les aspects juridiques et déontologiques à respecter lors de la construction des projets de télémédecine et dans sa pratique. Il comporte deux parties : L'analyse du CNOM pour l'application pratique du cadre réglementaire, afin de constituer une base de doctrine déontologique pour l'examen des contrats de Télémédecine prévus par le décret; La position du CNOM sur des prestations médicales qui se situent aux confins du cadre réglementaire et que le CNOM estime nécessaire de réguler.

Cour des Comptes (2017). La télémédecine : une stratégie cohérente à mettre en oeuvre. Sécurité sociale : Rapport 2017 sur l'application des lois de financement de la sécurité sociale., Paris : Cour des Comptes: 297-.

https://www.ccomptes.fr/sites/default/files/2017-09/20170920-rapport-securite-sociale-2017_1.pdf

À l'occasion de plusieurs de ses travaux récents, portant notamment sur la santé des personnes détenues, la santé dans les outre-mer, l'hospitalisation à domicile et l'imagerie médicale, la Cour avait relevé l'atout que pourrait représenter la télémédecine pour certains segments de l'offre de soins Elle a cherché à apprécier plus complètement par une enquête spécifique l'adéquation de l'action conduite par les pouvoirs publics aux enjeux et conditions du développement de la télémédecine. La télémédecine constitue en effet un levier potentiellement majeur de modernisation de système de santé français. Le caractère fragmentaire et désordonné des actions menées par les pouvoirs publics en maintient cependant le développement à un stade embryonnaire. Une stratégie d'ensemble cohérente, qui achève de lever les préalables techniques et juridiques et mette en place un cadre

tarifaire adapté à son expansion, est indispensable à la concrétisation de ses apports à l'efficacité des soins.

Fieec (2011). Etude sur la télésanté et la télémédecine en Europe. Paris ; FIEEC ; Paris ASIP: 2 vol. (168 +121), tab., graph., fig.

<http://esante.gouv.fr/actus/telemedecine/publication-de-l-etude-europeenne-fieec-asip-sante-sur-la-telemedecine-et-la>

Dans le cadre de leurs missions respectives et dans la continuité des politiques publiques menées en faveur d'un développement structuré et pérenne de la télémédecine en France (loi HPST de juillet 2009 et décret télémédecine d'octobre 2010), la Fédération des Industries Electriques, Electroniques et de Communication (FIEEC) et l'ASIP Santé ont piloté la réalisation d'une étude européenne sur le développement d'applications de télémédecine et de télésanté et dont les principaux enseignements ont été présentés au cours d'une conférence de presse le mardi 29 mars 2011.

Fisch, S. (2014). "Télémédecine : une politique publique au service d'une révolution dans l'offre de soins." Actualite Et Dossier En Sante Publique(89): 9-11.

[BDSP. Notice produite par EHESP q79mR0xs. Diffusion soumise à autorisation]. Le développement de la télémédecine dans l'offre de soins français est porteur de beaucoup d'espoirs, tant au niveau de la qualité, de l'accessibilité, que de l'efficacité de notre système de santé.

HAS (2011). Efficacité de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS: 41, tabl., fig.

Cette note de cadrage concerne la mise en œuvre d'une évaluation médico-économique de la télémédecine par un état des lieux de la littérature internationale. Cette évaluation s'inscrit dans une optique d'aide à la décision publique. Elle vise à apporter des éléments de cadrage sur le déploiement de la télémédecine en France concernant les trois objectifs suivants : Contribuer à la définition d'axes prioritaires de déploiement de la télémédecine à partir de l'identification des projets pilotes et expérimentations les plus efficaces ; proposer un cadre d'évaluation médico-économique en fonction des indicateurs recensés et d'une classification des projets de télémédecine ; identifier des modèles économiques afin de proposer des éléments permettant d'orienter la politique de financement. La réalisation de cette évaluation a pour origine la volonté des pouvoirs publics et des acteurs de terrain de déployer la télémédecine en France. A la suite du décret relatif à la télémédecine publié en octobre 2010, la Direction Générale de l'organisation des soins a annoncé, début 2011, la mise en place d'un plan triennal de déploiement national de la télémédecine. Dans cette dynamique actuelle, les attentes du demandeur sont doubles : d'une part, contribuer à alimenter les axes d'orientation de la politique de déploiement de la télémédecine, et, d'autre part, proposer des outils d'évaluation des expérimentations et projets pilotes concernant les aspects médico-économiques

HAS (2013). Efficacité de la télémédecine : état des lieux de la littérature internationale et cadre d'évaluation. Note de cadrage. St Denis La Plaine HAS: 154 , tabl., fig., ann.

https://www.has-sante.fr/jcms/c_1622477/fr/efficacite-de-la-telemedecine-etat-des-lieux-de-la-litterature-internationale-et-cadre-d-evaluation

La télémédecine est une forme de pratique médicale à distance fondée sur l'utilisation des technologies de l'information et de la communication, qui fait l'objet depuis 2011 d'une

stratégie nationale de déploiement. Les attentes autour de la télémédecine sont aujourd'hui très importantes et son développement confronte les pouvoirs publics, les patients et les professionnels à de nouvelles problématiques, en particulier celle de l'évaluation médico-économique des projets. La demande de la DGOS à l'origine de ce rapport s'inscrit dans une optique d'aide à la décision publique. A partir d'une revue de la littérature internationale portant sur l'évaluation médico-économique de la télémédecine, sans délimitation du champ à un domaine d'application spécifique, l'objectif de ce rapport est double : Réaliser un état des lieux des études d'évaluation médico-économique de la télémédecine et apprécier l'apport de cette littérature pour alimenter les réflexions concernant la question de l'efficacité de cette forme de pratique médicale, la définition d'axes de déploiement et l'identification de modèles de financement ; Proposer un cadre d'évaluation médico-économique afin de favoriser la mise en œuvre d'évaluations dans le contexte français.

Midy, F., Polton, D., Strauss, A., et al. (2000). Télémédecine & évaluation. Aide méthodologique à l'évaluation de la télémédecine. Rapport Credes. Paris M.S.S.P.S.: 80 , tabl., graph.

Ce document a pour objectif de faire le point sur ce qu'il est raisonnable d'envisager en termes d'évaluation dans le domaine de la télémédecine. Dans un premier chapitre, les auteurs délimitent leur champ de réflexion en précisant les attendus de l'implantation de la télémédecine ainsi que les objectifs de l'évaluation. Ils font le point dans un deuxième chapitre sur les expériences qui sont décrites dans la littérature internationale et qui présentent un intérêt en termes d'évaluation. Les expériences (françaises et québécoises), pour lesquelles les auteurs ont mené une observation directe sont synthétisées dans le troisième chapitre. Le quatrième chapitre décline quelques principes généraux d'évaluation sous la forme d'un guide d'aide à l'évaluation illustré par des exemples.

Simon, O. et Acker, D. (2008). La place de la télémédecine dans l'organisation des soins. Paris Mssps: 160 , tabl., fig., cartes, ann.

Ce rapport concerne l'organisation des soins par la télémédecine, acte médical à distance tel qu'il est défini dans la loi du 14 août 2004. Après avoir défini le cadre déontologique et juridique de la télémédecine et son impact sur l'exercice professionnel (1), le rapport fera l'état des lieux des réalisations et des projets en France, en Europe et dans le Monde (2), analysera les enjeux à court et moyen termes, en déclinant les besoins par grands types de pathologies et par modes d'activité de soins (3), identifiera les principaux freins à son développement (4), fera des recommandations pour que sa mise en œuvre soit la plus efficace possible afin d'apporter une réponse adaptée aux attentes des patients et des professionnels de santé (5).

Simon, P. (2015). Télémédecine : enjeux et pratiques, Brignais : Editions Le Coudrier
<http://www.edition-lecoudrier.fr/produit/7/9782919374069/Telemedecine%20-%20Enjeux%20et%20pratiques>

En médecine comme dans d'autres secteurs, les technologies modernes de communication ont ouvert de nouvelles possibilités. Grâce à elles, de nombreuses pratiques à distance ont vu le jour depuis les années 1990. Quelles sont ces pratiques ? Ont-elles fait leurs preuves ? Qu'apportent-elles aux patients, aux soignants et à la santé publique ? Feront-elles bientôt partie de notre quotidien ? Ce livre offre un point complet sur le sujet. Après avoir défini le champ et précisé les termes et les enjeux de la télémédecine, l'auteur raconte l'histoire des pays pionniers, dont fait partie la France. Il présente ensuite ce qu'il faut savoir des pratiques de télémédecine : la politique nationale, les cinq actes reconnus depuis 2010, les responsabilités engagées et la façon de mettre en œuvre un projet. Il termine l'ouvrage en

détaillant les applications développées dans chaque spécialité et en présentant une sélection d'articles scientifiques pour chacune d'entre elles. Un ouvrage de référence pour tous ceux qui s'interrogent sur les enjeux et les pratiques de la télémédecine.

L'évaluation de la télésurveillance

Définition de la télésurveillance

La télésurveillance médicale a pour objet de permettre à un professionnel de santé d'interpréter à distance des données nécessaires au suivi médical d'un patient et, le cas échéant, de prendre des décisions relatives à sa prise en charge. L'enregistrement et la transmission des données peuvent être automatisés ou réalisés par le patient lui-même ou par un professionnel de santé. En pratique, la télésurveillance repose sur le suivi d'indicateurs cliniques ou techniques à distance avec identification d'alertes ; ces données sont interprétées par un médecin qui peut mettre en place une prise en charge adaptée. La particularité de la télésurveillance réside dans ce qu'elle apporte comme complément d'information permettant un suivi régulier voire permanent du patient et une intervention au plus tôt si nécessaire. Les conditions de son développement dépendent de l'organisation du suivi mis en place, l'attitude des professionnels de santé et aussi, le rôle du patient dans la gestion de sa santé. La télésurveillance a pour enjeu d'améliorer la qualité de la prise en charge, de réduire les inégalités d'accès aux soins pour les usagers isolés géographiquement ou socialement, de simplifier le suivi et d'améliorer la qualité de vie dans un contexte de vieillissement de la population et d'augmentation des pathologies chroniques en permettant une prise en charge au plus près du lieu de vie. À compter du 1er janvier 2018 et pour une durée maximale de 4 ans, l'article 54 de la LFSS pour 2018 prévoit la mise en œuvre d'expérimentations relatives à la réalisation d'actes de télésurveillance selon les conditions prévues dans les cinq cahiers des charges des expérimentations ETAPES structurés par pathologie : insuffisance cardiaque chronique, insuffisance rénale chronique, insuffisance respiratoire chronique, diabète, patients porteurs de prothèses cardiaques implantables à visée thérapeutique. La loi précise aussi les modalités de mise en œuvre des expérimentations de télésurveillance : périmètre, missions et engagements des acteurs impliqués ainsi que ceux des organismes de tutelle et de financement, modalités de l'évaluation. Selon une volonté de simplification du cadre expérimental, l'article 91 de la LFSS pour 2017 a modifié le rôle de la HAS en lui confiant la mission de valider l'évaluation effectuée par un organisme évaluateur. L'évaluation vise à apprécier l'impact des expérimentations suivant le cadre d'évaluation publié par la Haute Autorité de santé (HAS) en juillet 2013. Elle fera l'objet d'un rapport d'évaluation validé par la HAS et transmis au Parlement par le Gouvernement avant le 30 juin 2021. L'objectif de ces expérimentations est de faciliter le déploiement de la télésurveillance en tant que forme de télémédecine au bénéfice des patients qu'ils soient pris en charge en ville (domicile, cabinet médical ou structure d'exercice coordonné), en établissement de santé ou en structure médico-sociale afin de permettre sa généralisation et son entrée dans le droit commun (dans le cadre des négociations conventionnelles).

LES ETUDES D'ÉVALUATION ÉCONOMIQUE : REVUES DE LITTÉRATURE

Boling, P. A., Chandekar, R. V., Hungate, B., et al. (2013). "Improving outcomes and lowering costs by applying advanced models of in-home care." Cleve Clin J Med **80 Electronic Suppl 1**: eS7-14.

With advances in monitoring and telemedicine, the complexity of care administered in the home to properly selected patients can approach that delivered in the hospital. The challenges include making sure that qualified personnel regularly visit the patient at home, both individually and in teams; information is accurately communicated among the caregiver teams across venues and over time; and patients understand the information communicated to them by providers. Despite these challenges, the benefits of treating chronically or terminally ill patients at home are significant. Among the most important are improved patient satisfaction and reduced cost. Numerous studies have shown that most patients prefer to spend their convalescence or their last days at home. The financial benefits of enabling patients to recover or to die at home are significant.

Bounthavong, M., Pruitt, L. D., Smolenski, D. J., et al. (2018). "Economic evaluation of home-based telebehavioural health care compared to in-person treatment delivery for depression." J Telemed Telecare **24(2)**: 84-92.

Introduction Home-based telebehavioural healthcare improves access to mental health care for patients restricted by travel burden. However, there is limited evidence assessing the economic value of home-based telebehavioural health care compared to in-person care. We

sought to compare the economic impact of home-based telebehavioural health care and in-person care for depression among current and former US service members. **Methods** We performed trial-based cost-minimisation and cost-utility analyses to assess the economic impact of home-based telebehavioural health care versus in-person behavioural care for depression. Our analyses focused on the payer perspective (Department of Defense and Department of Veterans Affairs) at three months. We also performed a scenario analysis where all patients possessed video-conferencing technology that was approved by these agencies. The cost-utility analysis evaluated the impact of different depression categories on the incremental cost-effectiveness ratio. One-way and probabilistic sensitivity analyses were performed to test the robustness of the model assumptions. **Results** In the base case analysis the total direct cost of home-based telebehavioural health care was higher than in-person care (US\$71,974 versus US\$20,322). Assuming that patients possessed government-approved video-conferencing technology, home-based telebehavioural health care was less costly compared to in-person care (US\$19,177 versus US\$20,322). In one-way sensitivity analyses, the proportion of patients possessing personal computers was a major driver of direct costs. In the cost-utility analysis, home-based telebehavioural health care was dominant when patients possessed video-conferencing technology. Results from probabilistic sensitivity analyses did not differ substantially from base case results. **Discussion** Home-based telebehavioural health care is dependent on the cost of supplying video-conferencing technology to patients but offers the opportunity to increase access to care. Health-care policies centred on implementation of home-based telebehavioural health care should ensure that these technologies are able to be successfully deployed on patients' existing technology.

Bourbeau, J., Casan, P., Tognella, S., et al. (2016). "An international randomized study of a home-based self-management program for severe COPD: the COMET." *Int J Chron Obstruct Pulmon Dis* **11**: 1447-1451.

INTRODUCTION: Most hospitalizations and costs related to COPD are due to exacerbations and insufficient disease management. The COPD patient Management European Trial (COMET) is investigating a home-based multicomponent COPD self-management program designed to reduce exacerbations and hospital admissions. **DESIGN:** Multicenter parallel randomized controlled, open-label superiority trial. **SETTING:** Thirty-three hospitals in four European countries. **PARTICIPANTS:** A total of 345 patients with Global initiative for chronic Obstructive Lung Disease III/IV COPD. **INTERVENTION:** The program includes extensive patient coaching by health care professionals to improve self-management (eg, develop skills to better manage their disease), an e-health platform for reporting frequent health status updates, rapid intervention when necessary, and oxygen therapy monitoring. **Comparator** is the usual management as per the center's routine practice. **MAIN OUTCOME MEASURES:** Yearly number of hospital days for acute care, exacerbation number, quality of life, deaths, and costs.

Boyne, J. J., Van Asselt, A. D., Gorgels, A. P., et al. (2013). "Cost-effectiveness analysis of telemonitoring versus usual care in patients with heart failure: the TEHAF-study." *J Telemed Telecare* **19**(5): 242-248.

We examined the incremental cost-effectiveness of telemonitoring (TM) versus usual care (UC) in patients with congestive heart failure (CHF). In one university and two general hospitals, 382 patients were randomised to usual care or telemonitoring and followed for 1 year. Hospital-related and home costs were estimated, based on resource use multiplied by the appropriate unit prices. Effectiveness was expressed as QALYs gained. Information was gathered, using 3 monthly costs diaries and questionnaires. The mean age of the patients

was 71 years (range 32-93), 59% were male and 64% lived with a partner. Health related quality of life improved by 0.07 points for the usual care and 0.1 points for the telemonitoring group, but the difference between groups was not significant. There were no significant differences in annual costs per patient between groups. At a threshold of euro50,000 the probability of telemonitoring being cost-effective was 48%. The cost effectiveness analysis showed a high level of decision uncertainty, probably caused by the divergence between the participating institutions. It is therefore premature to draw an unambiguous conclusion regarding cost-effectiveness for the whole group.

Burri, H., Sticherling, C., Wright, D., et al. (2013). "Cost-consequence analysis of daily continuous remote monitoring of implantable cardiac defibrillator and resynchronization devices in the UK." *Europace* **15**(11): 1601-1608.

AIMS: The need for ongoing and lifelong follow-up (FU) of patients with cardiac implantable electric devices (CIED) requires significant resources. Remote CIED management has been established as a safe alternative to conventional periodical in-office FU (CFU). An economic model compares the long-term cost and consequences of using daily Home Monitoring(R) (HM) instead of CFU. METHODS AND RESULTS: A cost-consequence evaluation comparing HM vs. CFU was performed using a Markov cohort model and data relating to events and costs identified via a systematic review of the literature. The model is conservative, without assuming a reduction of cardiovascular events by HM such as decompensated heart failure or mortality, or considering cost savings such as for transportation. Also cost savings due to an improved timing of elective device replacement, and fewer FU visits needed in patients near device replacement are not considered. Over 10 years, HM is predicted to be cost neutral at about GBP 11 500 per patient in either treatment arm, with all costs for the initial investment into HM and fees for ongoing remote monitoring included. Fewer inappropriate shocks (-51%) reduce the need for replacing devices for battery exhaustion (-7%); the number of FU visits is predicted to be halved by HM. CONCLUSION: From a UK National Health Service perspective, HM is cost neutral over 10 years. This is mainly accomplished by reducing the number of battery charges and inappropriate shocks, resulting in fewer device replacements, and by reducing the number of in-clinic FU visits.

Cheung, K. L., Wijnen, B. et de Vries, H. (2017). "A Review of the Theoretical Basis, Effects, and Cost Effectiveness of Online Smoking Cessation Interventions in the Netherlands: A Mixed-Methods Approach." *J Med Internet Res* **19**(6): e230.

BACKGROUND: Tobacco smoking is a worldwide public health problem. In 2015, 26.3% of the Dutch population aged 18 years and older smoked, 74.4% of them daily. More and more people have access to the Internet worldwide; approximately 94% of the Dutch population have online access. Internet-based smoking cessation interventions (online cessation interventions) provide an opportunity to tackle the scourge of tobacco. OBJECTIVE: The goal of this paper was to provide an overview of online cessation interventions in the Netherlands, while exploring their effectivity, cost effectiveness, and theoretical basis. METHODS: A mixed-methods approach was used to identify Dutch online cessation interventions, using (1) a scientific literature search, (2) a grey literature search, and (3) expert input. For the scientific literature, the Cochrane review was used and updated by two independent researchers (n=651 identified studies), screening titles, abstracts, and then full-text studies between 2013 and 2016 (CENTRAL, MEDLINE, and EMBASE). For the grey literature, the researchers conducted a Google search (n=100 websites), screening for titles and first pages. Including expert input, this resulted in six interventions identified in the scientific literature and 39 interventions via the grey literature. Extracted data included effectiveness, cost effectiveness, theoretical factors, and behavior change techniques used.

RESULTS: Overall, many interventions (45 identified) were offered. Of the 45 that we identified, only six that were included in trials provided data on effectiveness. Four of these were shown to be effective and cost effective. In the scientific literature, 83% (5/6) of these interventions included changing attitudes, providing social support, increasing self-efficacy, motivating smokers to make concrete action plans to prepare their attempts to quit and to cope with challenges, supporting identity change and advising on changing routines, coping, and medication use. In all, 50% (3/6) of the interventions included a reward for abstinence. Interventions identified in the grey literature were less consistent, with inclusion of each theoretical factor ranging from 31% to 67% and of each behavior change technique ranging from 28% to 54%. **CONCLUSIONS:** Although the Internet may provide the opportunity to offer various smoking cessation programs, the user is left bewildered as far as efficacy is concerned, as most of these data are not available nor offered to the smokers. Clear regulations about the effectiveness of these interventions need to be devised to avoid disappointment and failed quitting attempts. Thus, there is a need for policy regulations to regulate the proliferation of these interventions and to foster their quality in the Netherlands

Greenhalgh, T., A'Court, C. et Shaw, S. (2017). "Understanding heart failure; explaining telehealth - a hermeneutic systematic review." *BMC Cardiovasc Disord* **17**(1): 156.

BACKGROUND: Enthusiasts for telehealth extol its potential for supporting heart failure management. But randomised trials have been slow to recruit and produced conflicting findings; real-world roll-out has been slow. We sought to inform policy by making sense of a complex literature on heart failure and its remote management. **METHODS:** Through database searching and citation tracking, we identified 7 systematic reviews of systematic reviews, 32 systematic reviews (including 17 meta-analyses and 8 qualitative reviews); six mega-trials and over 60 additional relevant empirical studies and commentaries. We synthesised these using Boell's hermeneutic methodology for systematic review, which emphasises the quest for understanding. **RESULTS:** Heart failure is a complex and serious condition with frequent co-morbidity and diverse manifestations including severe tiredness. Patients are often frightened, bewildered, socially isolated and variably able to self-manage. Remote monitoring technologies are many and varied; they create new forms of knowledge and new possibilities for care but require fundamental changes to clinical roles and service models and place substantial burdens on patients, carers and staff. The policy innovation of remote biomarker monitoring enabling timely adjustment of medication, mediated by "activated" patients, is based on a modernist vision of efficient, rational, technology-mediated and guideline-driven ("cold") care. It contrasts with relationship-based ("warm") care valued by some clinicians and by patients who are older, sicker and less technically savvy. Limited uptake of telehealth can be analysed in terms of key tensions: between tidy, "textbook" heart failure and the reality of multiple comorbidities; between basic and intensive telehealth; between activated, well-supported patients and vulnerable, unsupported ones; between "cold" and "warm" telehealth; and between fixed and agile care programmes. **CONCLUSION:** The limited adoption of telehealth for heart failure has complex clinical, professional and institutional causes, which are unlikely to be elucidated by adding more randomised trials of technology-on versus technology-off to an already-crowded literature. An alternative approach is proposed, based on naturalistic study designs, application of social and organisational theory, and co-design of new service models based on socio-technical principles. Conventional systematic reviews (whose goal is synthesising data) can be usefully supplemented by hermeneutic reviews (whose goal is deepening understanding).

Hameed, A. S., Sauermann, S. et Schreier, G. (2014). "The impact of adherence on costs and effectiveness of telemedical patient management in heart failure: a systematic review." *Appl Clin Inform* 5(3): 612-620.

OBJECTIVE: This paper analyzes evidence of the impact of patients' adherence to pharmacological and non-pharmacological recommendations on the treatment costs of heart failure (HF) patients. **METHODS:** A systematic review was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Papers were searched using various combinations of the following keywords: 'telemedicine', 'telemonitoring', 'telehealth', 'eHealth', 'remote monitoring', 'adherence', 'compliance', 'cost-effectiveness', 'cost-benefit', 'heart failure', 'healthcare costs', 'hospitalization', and 'drug costs'. We included only papers written in English or German, published between 1998 and 2014, and having one of our search terms in the title. **RESULTS:** Initially, 73 papers were selected. After a detailed review, these were narrowed down to 9 that reported an association between adherence and/or compliance and costs. However, none established a quantitative relationship between adherence and total healthcare costs. **CONCLUSION:** A model-based cost-effectiveness analysis that appropriately considers adherence has not been carried out so far, but is needed to fully understand the potential economic benefits of telehealth.

Lanssens, D., Vandenberk, T., Thijs, I. M., et al. (2017). "Effectiveness of Telemonitoring in Obstetrics: Scoping Review." *J Med Internet Res* 19(9): e327.

BACKGROUND: Despite reported positive results of telemonitoring effectiveness in various health care domains, this new technology is rarely used in prenatal care. A few isolated investigations were performed in the past years but with conflicting results. **OBJECTIVE:** The aim of this review was to (1) assess whether telemonitoring adds any substantial benefit to this patient population and (2) identify research gaps in this area to suggest goals for future research. **METHODS:** This review includes studies exploring the effectiveness of telemonitoring interventions for pregnant women reported in the English language. Due to the paucity of research in this area, all reports including uncontrolled nonrandomized and randomized controlled studies were selected. **RESULTS:** Fourteen studies, which performed their data collection from 1988 to 2010, met the inclusion criteria and were published from 1995 to present; four of the 14 published papers were multicenter randomized controlled trials (RCTs), five papers were single-center RCTs, three papers were retrospective studies, one paper was an observational study, and one paper was a qualitative study. Of the 14 papers, nine were available for a risk of bias assessment: three papers were classified as low risk, one as medium risk, and five as high risk. Furthermore, of those 14 papers, 13 focused on telemonitoring for maternal outcomes, and nine of the 14 papers focused on telemonitoring for fetal or neonatal outcomes. The studies reviewed report that telemonitoring can contribute to significant reductions in health care costs, (unscheduled) face-to-face visits, low neonatal birth weight, and admissions to the neonatal intensive care unit (NICU), as well as prolonged gestational age and improved feelings of maternal satisfaction when compared with a control group. When only studies with low risk of bias were taken into account, the added value of telemonitoring became less pronounced: the only added value of telemonitoring is for pregnant women who transmitted their uterine activity by telecommunication. They had significant prolonged pregnancy survivals, and the newborns were less likely to be of low birth weight or to be admitted to the NICU. Following these results, telemonitoring can only be recommended by pregnant women at risk for preterm delivery. It is however important to consider that these studies were published in the mid-90s, which limits their direct applicability given the current technologies and practice. **CONCLUSIONS:** This review shows that telemonitoring can be tentatively

recommended for pregnant women at risk for preterm delivery. More recent RCTs with a blinded protocol are needed to strengthen the level of evidence around this topic and to have an insight in the added value of the technologies that are available nowadays. In addition, studies investigating patient satisfaction and economic effects in relation to telemonitoring are suggested for future research.

Lopez-Villegas, A., Catalan-Matamoros, D., Martin-Saborido, C., et al. (2016). "A Systematic Review of Economic Evaluations of Pacemaker Telemonitoring Systems." *Rev Esp Cardiol (Engl Ed)* **69**(2): 125-133.

INTRODUCTION AND OBJECTIVES: Over the last decade, telemedicine applied to pacemaker monitoring has undergone extraordinary growth. It is not known if telemonitoring is more or less efficient than conventional monitoring. The aim of this study was to carry out a systematic review analyzing the available evidence on resource use and health outcomes in both follow-up modalities. **METHODS:** We searched 11 databases and included studies published up until November 2014. The inclusion criteria were: a) experimental or observational design; b) studies based on complete economic evaluations; c) patients with pacemakers, and d) telemonitoring compared with conventional hospital monitoring. **RESULTS:** Seven studies met the inclusion criteria, providing information on 2852 patients, with a mean age of 81 years. The main indication for device implantation was atrioventricular block. With telemonitoring, cardiovascular events were detected and treated 2 months earlier than with conventional monitoring, thus reducing length of hospital stay by 34% and reducing routine and emergency hospital visits as well. There were no significant intergroup differences in perceived quality of life or number of adverse events. The cost of telemonitoring was 60% lower than that of conventional hospital monitoring. **CONCLUSIONS:** Compared with conventional monitoring, cardiovascular events were detected earlier and the number of hospitalizations and hospital visits was reduced with pacemaker telemonitoring. In addition, the costs associated with follow-up were lower with telemonitoring.

Massoudi, B., Holvast, F., Bockting, C. L. H., et al. (2019). "The effectiveness and cost-effectiveness of e-health interventions for depression and anxiety in primary care: A systematic review and meta-analysis." *J Affect Disord* **245**: 728-743.

PURPOSE: Psychological interventions are labor-intensive and expensive, but e-health interventions may support them in primary care. In this study, we systematically reviewed the effectiveness and cost-effectiveness of e-health interventions for depressive and anxiety symptoms and disorders in primary care. **METHODS:** We searched MEDLINE, Cochrane library, Embase, and PsychINFO until January 2018, for randomized controlled trials of e-health interventions for depression or anxiety in primary care. Two reviewers independently screened the identified publications, extracted data, and assessed risk of bias using the Cochrane Collaboration's tool. **RESULTS:** Out of 3617 publications, we included 14 that compared 33 treatments in 4183 participants. Overall, the methodological quality was poor to fair. The pooled effect size of e-health interventions was small (standardized mean difference=-0.19, 95%CI -0.31 to -0.06) for depression compared to control groups in the short-term, but this was maintained in the long-term (standardized mean difference=-0.22, 95%CI -0.35 to -0.09). Further analysis showed that e-health for depression had a small effect compared to care as usual and a moderate effect compared to waiting lists. One trial on anxiety showed no significant results. Four trials reported on cost-effectiveness. **LIMITATIONS:** The trials studied different types of e-health interventions and had several risks of bias. Moreover, only one study was included for anxiety. **CONCLUSIONS:** E-health interventions for depression have a small effect in primary care, with a moderate effect

compared to waiting lists. The approach also appeared to be cost-effective for depression. However, we found no evidence.

Michaud, T. L., Zhou, J., McCarthy, M. A., et al. (2018). "COSTS OF HOME-BASED TELEMEDICINE PROGRAMS: A SYSTEMATIC REVIEW." *Int J Technol Assess Health Care* **34**(4): 410-418.

OBJECTIVES: The aim of this study was to systematically investigate existing literature on the costs of home-based telemedicine programs, and to further summarize how the costs of these telemedicine programs vary by equipment and services provided. **METHODS:** We undertook a systematic review of related literature by searching electronic bibliographic databases and identifying studies published from January 1, 2000, to November 30, 2017. The search was restricted to studies published in English, results from adult patients, and evaluation of home telemedicine programs implemented in the United States. Summarized telemedicine costs per unit of outcome measures were reported. **RESULTS:** Twelve studies were eligible for our review. The overall annual cost of providing home-based telemedicine varied substantially depending on specific chronic conditions, ranging from USD1,352 for heart failure to USD206,718 for congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes as a whole. The estimated cost per-patient-visit ranged from USD24 for cancer to USD39 for CHF, COPD, or chronic wound care. **CONCLUSIONS:** The costs of home-based telemedicine programs varied substantially by program components, disease type, equipment used, and services provided. All the selected studies indicated that home telemedicine programs reduced care costs, although detailed cost data were either incomplete or not presented in detail. A comprehensive analysis of the cost of home-based telemedicine programs and their determinants is still required before the cost efficiency of these programs can be better understood, which becomes crucial for these programs to be more widely adopted and reimbursed.

Moshi, M. R., Tooher, R. et Merlin, T. (2018). "SUITABILITY OF CURRENT EVALUATION FRAMEWORKS FOR USE IN THE HEALTH TECHNOLOGY ASSESSMENT OF MOBILE MEDICAL APPLICATIONS: A SYSTEMATIC REVIEW." *Int J Technol Assess Health Care* **34**(5): 464-475.

OBJECTIVES: To identify and appraise existing evaluation frameworks for mobile medical applications (MMA) and determine their suitability for use in health technology assessment (HTA) of these technologies. **METHODS:** Systematic searches were conducted of seven bibliographic databases to identify literature published between 2008 and 2016 on MMA evaluation frameworks. Frameworks were eligible if they were used to evaluate at least one of the HTA domains of effectiveness, safety, and/or cost and cost-effectiveness of an MMA. After inclusion, the frameworks were reviewed to determine the number and extent to which other elements of an HTA were addressed by the framework. **RESULTS:** A total of forty-five frameworks were identified that assessed MMAs. All frameworks assessed whether the app was effective. Of the thirty-four frameworks that examined safety, only seven overtly evaluated potential harms from the MMA (e.g., the impact of inaccurate information). Only one framework explicitly considered a comparator. Technology specific domains were sporadically addressed. **CONCLUSION:** None of the evaluation frameworks could be used, unaltered, to guide the HTA of MMAs. To use these frameworks in HTA they would need to identify relevant comparators, improve assessments of harms and consider the ongoing effect of software updates on the safety and effectiveness of MMAs. Attention should also be paid to ethical issues, such as data privacy, and technology specific characteristics. **IMPLICATIONS:** Existing MMA evaluation frameworks are not suitable for use in HTA. Further research is needed before an MMA evaluation framework can be developed that will adequately inform policy makers.

Olsen, R., Bihlet, A. R., Kalakou, F., et al. (2016). "The impact of clinical trial monitoring approaches on data integrity and cost--a review of current literature." *Eur J Clin Pharmacol* **72**(4): 399-412.

PURPOSE: Monitoring is a costly requirement when conducting clinical trials. New regulatory guidance encourages the industry to consider alternative monitoring methods to the traditional 100 % source data verification (SDV) approach. The purpose of this literature review is to provide an overview of publications on different monitoring methods and their impact on subject safety data, data integrity, and monitoring cost. **METHODS:** The literature search was performed by keyword searches in MEDLINE and hand search of key journals. All publications were reviewed for details on how a monitoring approach impacted subject safety data, data integrity, or monitoring costs. **RESULTS:** Twenty-two publications were identified. Three publications showed that SDV has some value for detection of not initially reported adverse events and centralized statistical monitoring (CSM) captures atypical trends. Fourteen publications showed little objective evidence of improved data integrity with traditional monitoring such as 100 % SDV and sponsor queries as compared to reduced SDV, CSM, and remote monitoring. Eight publications proposed a potential for significant cost reductions of monitoring by reducing SDV without compromising the validity of the trial results. **CONCLUSIONS:** One hundred percent SDV is not a rational method of ensuring data integrity and subject safety based on the high cost, and this literature review indicates that reduced SDV is a viable monitoring method. Alternative methods of monitoring such as centralized monitoring utilizing statistical tests are promising alternatives but have limitations as stand-alone tools. Reduced SDV combined with a centralized, risk-based approach may be the ideal solution to reduce monitoring costs while improving essential data quality.

Paganini, S., Teigelkotter, W., Buntrock, C., et al. (2018). "Economic evaluations of internet- and mobile-based interventions for the treatment and prevention of depression: A systematic review." *J Affect Disord* **225**: 733-755.

BACKGROUND: Internet- and mobile-based interventions (IMIs) targeting depression have been shown to be clinically effective and are considered a cost-effective complement to established interventions. The aim of this review was to provide an overview of the evidence for the cost-effectiveness of IMIs for the treatment and prevention of depression. **METHODS:** A systematic database search was conducted (Medline, PsychInfo, CENTRAL, PSYINDEX, OHE HEED). Relevant articles were selected according to defined eligibility criteria. IMIs were classified as cost-effective if they were below a willingness-to-pay threshold (WTP) of euro22,845 (pound20,000) - euro34,267 (pound30,000) per additional quality-adjusted life year (QALY) according to the National Institute for Health and Clinical Excellence (NICE) standard. Study quality was assessed using the Consolidated Health Economic Evaluation Reporting Standard guidelines and the Cochrane Risk of Bias Tool. **RESULTS:** Of 1538 studies, seven economic evaluations of IMIs for the treatment of major depression, four for the treatment of subthreshold/minor depression and one for the prevention of depression. In six studies, IMIs were classified as likely to be cost-effective with an incremental cost-utility ratio between euro3088 and euro22,609. All of these IMIs were guided. Overall quality of most economic evaluations was evaluated as good. All studies showed some risk of bias. **LIMITATIONS:** The studies used different methodologies and showed some risk of bias. These aspects as well as the classification of cost-effectiveness according to the WTP proposed by NICE should be considered when interpreting the results. **CONCLUSIONS:** Results indicate that guided IMIs for the treatment of (subthreshold) depression have the potential to be a cost-effective complement to established interventions, but more methodologically sound studies are needed.

Sanyal, C., Stolee, P., Juzwishin, D., et al. (2018). "Economic evaluations of eHealth technologies: A systematic review." *PLoS One* **13**(6): e0198112.

BACKGROUND: Innovations in eHealth technologies have the potential to help older adults live independently, maintain their quality of life, and to reduce their health system dependency and health care expenditure. The objective of this study was to systematically review and appraise the quality of cost-effectiveness or utility studies assessing eHealth technologies in study populations involving older adults. **METHODS:** We systematically searched multiple databases (MEDLINE, EMBASE, CINAHL, NHS EED, and PsycINFO) for peer-reviewed studies published in English from 2000 to 2016 that examined cost-effectiveness (or utility) of eHealth technologies. The reporting quality of included studies was appraised using the Consolidated Health Economic Evaluation Reporting Standards statement. **RESULTS:** Eleven full text articles met the inclusion criteria representing public and private health care systems. eHealth technologies evaluated by these studies includes computerized decision support system, a web-based physical activity intervention, internet-delivered cognitive behavioral therapy, telecare, and telehealth. Overall, the reporting quality of the studies included in the review was varied. Most studies demonstrated efficacy and cost-effectiveness of an intervention using a randomized control trial and statistical modeling, respectively. This review found limited information on the feasibility of adopting these technologies based on economic and organizational factors. **CONCLUSIONS:** This review identified few economic evaluations of eHealth technologies that included older adults. The quality of the current evidence is limited and further research is warranted to clearly demonstrate the long-term cost-effectiveness of eHealth technologies from the health care system and societal perspectives.

Teljeur, C., Moran, P. S., Walshe, S., et al. (2017). "Economic evaluation of chronic disease self-management for people with diabetes: a systematic review." *Diabet Med* **34**(8): 1040-1049.

AIMS: To systematically review the evidence on the costs and cost-effectiveness of self-management support interventions for people with diabetes. **BACKGROUND:** Self-management support is the provision of education and supportive interventions to increase patients' skills and confidence in managing their health problems, potentially leading to improvements in HbA1c levels in people with diabetes. **METHODS:** Randomized controlled trials, observational studies or economic modelling studies were eligible for inclusion in the review. The target population was adults with diabetes. Interventions had to have a substantial component of self-management support and be compared with routine care. Study quality was evaluated using the Consensus on Health Economic Criteria and International Society of Pharmacoeconomic Outcomes Research questionnaires. A narrative review approach was used. **RESULTS:** A total of 16 costing and 21 cost-effectiveness studies of a range of self-management support interventions were identified. There was reasonably consistent evidence across 22 studies evaluating education self-management support programmes suggesting these interventions are cost-effective or superior to usual care. Telemedicine-type interventions were more expensive than usual care and potentially not cost-effective. There was insufficient evidence regarding the other types of self-management interventions, including pharmacist-led and behavioural interventions. The identified studies were predominantly of poor quality, with outcomes based on short-term follow-up data and study designs at high risk of bias. **CONCLUSIONS:** Self-management support education programmes may be cost-effective. There was limited evidence regarding other formats of self-management support interventions. The poor quality of many of the studies undermines the evidence base regarding the economic efficiency of self-management support interventions for people with diabetes.

Zhai, Y. K., Zhu, W. J., Cai, Y. L., et al. (2014). "Clinical- and cost-effectiveness of telemedicine in type 2 diabetes mellitus: a systematic review and meta-analysis." *Medicine (Baltimore)* **93**(28): e312.

Emerging telemedicine programs offer potential low-cost solutions to the management of chronic disease. We sought to evaluate the clinical effectiveness and cost effectiveness of telemedicine approaches on glycemic control in patients with type 2 diabetes mellitus. Using terms related to type 2 diabetes and telemedicine, MEDLINE, Cochrane, EMBASE, and CINAHL Plus were searched to identify relevant studies published through February 28, 2014. Data from identified clinical trials were pooled according to telemedicine approach, and evaluated using conventional meta-analytical methods. We identified 47 articles, from 35 randomized controlled trials, reporting quantitative outcomes for hemoglobin A1c (HbA1c). Twelve of the 35 studies provided intervention via telephone, either in the form of a call or a text message; 19 studies tested internet-based programs, employing video-conferencing and/or informational websites; and four studies used interventions involving electronically transmitted recommendations made by clinicians in response to internet-based reporting by patients. Overall, pooled results from these studies revealed a small, but statistically significant, decrease in HbA1c following intervention, compared to conventional treatment (pooled difference in means=-0.37, 95% CI=-0.49 to -0.25, Z=-6.08, P<0.001). Only two of the 35 studies included assessment of cost-effectiveness. These studies were disparate, both in terms of overall expense and relative cost-effectiveness. Optimization of telemedicine approaches could potentially allow for more effective self-management of disease in type 2 diabetes patients, though evidence to-date is unconvincing. Furthermore, significant publication bias was detected, suggesting that the literature should be interpreted cautiously.

LES ETUDES D'EVALUATION CLINIQUE : REVUES DE LITTÉRATURE

AbuDagga, A., Resnick, H. E. et Alwan, M. (2010). "Impact of blood pressure telemonitoring on hypertension outcomes: a literature review." *Telemed J E Health* **16**(7): 830-838.

We searched five databases (PubMed, CINAHL, PsycINFO, EMBASE, and ProQuest) from 1995 to September 2009 to collect evidence on the impact of blood pressure (BP) telemonitoring on BP control and other outcomes in telemonitoring studies targeting patients with hypertension as a primary diagnosis. Fifteen articles met our review criteria. We found that BP telemonitoring resulted in reduction of BP in all but two studies; systolic BP declined by 3.9 to 13.0 mm Hg and diastolic BP declined by 2.0 to 8.0 mm Hg across these studies. These magnitudes of effect are comparable to those observed in efficacy trials of some antihypertensive drugs. Although BP control was the primary outcome of these studies, some included secondary outcomes such as healthcare utilization and cost. Evidence of the benefits of BP telemonitoring on these secondary outcomes is less robust. Compliance with BP telemonitoring among patients was favorable, but compliance among participating healthcare providers was not well documented. The potential role of BP telemonitoring in the reduction of BP is discussed and suggestions on priority populations that can benefit from this technology are presented.

Band, R., Bradbury, K., Morton, K., et al. (2017). "Intervention planning for a digital intervention for self-management of hypertension: a theory-, evidence- and person-based approach." *Implement Sci* **12**(1): 25.

BACKGROUND: This paper describes the intervention planning process for the Home and Online Management and Evaluation of Blood Pressure (HOME BP), a digital intervention to promote hypertension self-management. It illustrates how a Person-Based Approach can be integrated with theory- and evidence-based approaches. The Person-Based Approach to intervention development emphasises the use of qualitative research to ensure that the intervention is acceptable, persuasive, engaging and easy to implement. **METHODS:** Our intervention planning process comprised two parallel, integrated work streams, which combined theory-, evidence- and person-based elements. The first work stream involved collating evidence from a mixed methods feasibility study, a systematic review and a synthesis of qualitative research. This evidence was analysed to identify likely barriers and facilitators to uptake and implementation as well as design features that should be incorporated in the HOME BP intervention. The second work stream used three complementary approaches to theoretical modelling: developing brief guiding principles for intervention design, causal modelling to map behaviour change techniques in the intervention onto the Behaviour Change Wheel and Normalisation Process Theory frameworks, and developing a logic model. **RESULTS:** The different elements of our integrated approach to intervention planning yielded important, complementary insights into how to design the intervention to maximise acceptability and ease of implementation by both patients and health professionals. From the primary and secondary evidence, we identified key barriers to overcome (such as patient and health professional concerns about side effects of escalating medication) and effective intervention ingredients (such as providing in-person support for making healthy behaviour changes). Our guiding principles highlighted unique design features that could address these issues (such as online reassurance and procedures for managing concerns). Causal modelling ensured that all relevant behavioural determinants had been addressed, and provided a complete description of the intervention. Our logic model linked the hypothesised mechanisms of action of our intervention to existing psychological theory. **CONCLUSION:** Our integrated approach to intervention development, combining theory-, evidence- and person-based approaches, increased the clarity, comprehensiveness and confidence of our theoretical modelling and enabled us to ground our intervention in an in-depth understanding of the barriers and facilitators most relevant to this specific intervention and user population.

Bashi, N., Karunanithi, M., Fatehi, F., et al. (2017). "Remote Monitoring of Patients With Heart Failure: An Overview of Systematic Reviews." *J Med Internet Res* **19**(1): e18.

BACKGROUND: Many systematic reviews exist on the use of remote patient monitoring (RPM) interventions to improve clinical outcomes and psychological well-being of patients with heart failure. However, research is broadly distributed from simple telephone-based to complex technology-based interventions. The scope and focus of such evidence also vary widely, creating challenges for clinicians who seek information on the effect of RPM interventions. **OBJECTIVE:** The aim of this study was to investigate the effects of RPM interventions on the health outcomes of patients with heart failure by synthesizing review-level evidence. **METHODS:** We searched PubMed, EMBASE, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and the Cochrane Library from 2005 to 2015. We screened reviews based on relevance to RPM interventions using criteria developed for this overview. Independent authors screened, selected, and extracted information from systematic reviews. AMSTAR (Assessment of Multiple Systematic Reviews) was used to assess the methodological quality of individual reviews. We used standardized language to summarize results across reviews and to provide final statements about intervention effectiveness. **RESULTS:** A total of 19 systematic reviews met our inclusion criteria. Reviews consisted of RPM with diverse interventions such as telemonitoring, home telehealth, mobile phone-based monitoring, and videoconferencing. All-cause mortality and heart failure

mortality were the most frequently reported outcomes, but others such as quality of life, rehospitalization, emergency department visits, and length of stay were also reported. Self-care and knowledge were less commonly identified. **CONCLUSIONS:** Telemonitoring and home telehealth appear generally effective in reducing heart failure rehospitalization and mortality. Other interventions, including the use of mobile phone-based monitoring and videoconferencing, require further investigation.

Birkhoff, S. D. et Smeltzer, S. C. (2017). "Perceptions of Smartphone User-Centered Mobile Health Tracking Apps Across Various Chronic Illness Populations: An Integrative Review." J Nurs Scholarsh **49**(4): 371-378.

PURPOSE: This integrative review presents a synthesis of the current qualitative research addressing the motivating factors, usability, and experiences of mobile health tracking applications (apps) across various chronic disease populations. **DESIGN:** Integrative review of the literature. **METHODS:** Databases used to conduct this integrative review included: PubMed Plus, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Google Scholar, Science Direct, and EBSCO megafile. The following search terms were used in all five databases: smartphone apps, apps, mHealth, eHealth, mobile health apps, health tracking apps, user-centered apps, wireless technology, engagement, qualitative, and usability. **FINDINGS:** The initial literature review yielded 689 results. Once inclusion and exclusion criteria were employed, 11 studies met the criteria set forth for this review. The reviewed studies provided insight into users' perceptions, experiences, and motivations to incorporate smartphone mobile health apps into their daily lives when living with chronic illnesses. **CONCLUSIONS:** This review indicates the growing interest in user-centered mobile health tracking apps, but with little understanding of motivating factors that foster sustained app use. Mobile health tracking apps targeted to users with chronic conditions need to have a high level of usability in order to motivate users to sustain engagement with their mobile health tracking app. **CLINICAL RELEVANCE:** User-centered mobile health tracking app technology is being used with increasing frequency to potentially provide individualized support to chronic illness populations.

Block, V. A., Pitsch, E., Tahir, P., et al. (2016). "Remote Physical Activity Monitoring in Neurological Disease: A Systematic Review." PLoS One **11**(4): e0154335.

OBJECTIVE: To perform a systematic review of studies using remote physical activity monitoring in neurological diseases, highlighting advances and determining gaps. **METHODS:** Studies were systematically identified in PubMed/MEDLINE, CINAHL and SCOPUS from January 2004 to December 2014 that monitored physical activity for ≥ 24 hours in adults with neurological diseases. Studies that measured only involuntary motor activity (tremor, seizures), energy expenditure or sleep were excluded. Feasibility, findings, and protocols were examined. **RESULTS:** 137 studies met inclusion criteria in multiple sclerosis (MS) (61 studies); stroke (41); Parkinson's Disease (PD) (20); dementia (11); traumatic brain injury (2) and ataxia (1). Physical activity levels measured by remote monitoring are consistently low in people with MS, stroke and dementia, and patterns of physical activity are altered in PD. In MS, decreased ambulatory activity assessed via remote monitoring is associated with greater disability and lower quality of life. In stroke, remote measures of upper limb function and ambulation are associated with functional recovery following rehabilitation and goal-directed interventions. In PD, remote monitoring may help to predict falls. In dementia, remote physical activity measures correlate with disease severity and can detect wandering. **CONCLUSIONS:** These studies show that remote physical activity monitoring is feasible in neurological diseases, including in people with moderate to severe neurological disability. Remote monitoring can be a psychometrically sound and responsive way to assess physical

activity in neurological disease. Further research is needed to ensure these tools provide meaningful information in the context of specific neurological disorders and patterns of neurological disability.

Boling, P. A., Chandekar, R. V., Hungate, B., et al. (2013). "Improving outcomes and lowering costs by applying advanced models of in-home care." *Cleve Clin J Med* **80 Electronic Suppl 1**: eS7-14.

With advances in monitoring and telemedicine, the complexity of care administered in the home to properly selected patients can approach that delivered in the hospital. The challenges include making sure that qualified personnel regularly visit the patient at home, both individually and in teams; information is accurately communicated among the caregiver teams across venues and over time; and patients understand the information communicated to them by providers. Despite these challenges, the benefits of treating chronically or terminally ill patients at home are significant. Among the most important are improved patient satisfaction and reduced cost. Numerous studies have shown that most patients prefer to spend their convalescence or their last days at home. The financial benefits of enabling patients to recover or to die at home are significant.

Bolton, C. E., Waters, C. S., Peirce, S., et al. (2011). "Insufficient evidence of benefit: a systematic review of home telemonitoring for COPD." *J Eval Clin Pract* **17(6)**: 1216-1222.

RATIONALE, AIMS AND OBJECTIVES: The evidence to support the effectiveness of home telemonitoring interventions for patients with chronic obstructive pulmonary disease (COPD) is limited, yet there are many efforts made to implement these technologies across health care services. **METHODS:** A comprehensive search strategy was designed and implemented across 9 electronic databases and 11 European, Australasian and North American telemedicine websites. Included studies had to examine the effectiveness of telemonitoring interventions, clearly defined for the study purposes, for adult patients with COPD. Two researchers independently screened each study prior to inclusion. **RESULTS:** Two randomized trials and four other evaluations of telemonitoring were included. The studies are typically underpowered, had heterogeneous patient populations and had a lack of detailed intervention descriptions and of the care processes that accompanied telemonitoring. In addition, there were diverse outcome measures and no economic evaluations. The telemonitoring interventions in each study differed widely. Some had an educational element that could itself account for the differences between groups. **CONCLUSIONS:** Despite these caveats, the study reports are themselves positive about their results. However, given the risk of bias in the design and scale of the evaluations we conclude that the benefit of telemonitoring for COPD is not yet proven and that further work is required before wide-scale implementation be supported.

Boots, L. M., de Vugt, M. E., Kempen, G. I., et al. (2016). "Effectiveness of the blended care self-management program "Partner in Balance" for early-stage dementia caregivers: study protocol for a randomized controlled trial." *Trials* **17(1)**: 231.

BACKGROUND: The benefits of e-health support for dementia caregivers are becoming increasingly recognized. Reaching early-stage dementia caregivers could prevent high levels of burden and psychological problems in them in the later stages of dementia. An iterative step-wise approach was employed to develop the blended care self-management program "Partner in Balance" for early-stage dementia caregivers. The design of a study evaluating the process characteristics and effects is presented. **METHODS/DESIGN:** A mixed-method, single-blind, randomized controlled trial with 80 family caregivers of community-dwelling people with (very) mild dementia will be conducted. Participants will be randomly assigned to either

the 8-week blended care self-management program "Partner in Balance" or a waiting-list control group. Data will be collected pre intervention and post intervention and at 3-, 6- and 12-month follow-ups. Semi-structured interviews will be conducted post intervention. A process evaluation will investigate the internal and external validity of the intervention. Primary outcomes will include self-efficacy and symptoms of depression. Secondary outcomes will include goal attainment, mastery, psychological complaints (feelings of anxiety and perceived stress), and quality of life. Possible modifying variables such as caregiver characteristics (quality of the relationship, neurotic personality) and interventional aspects (coach) on the intervention effect will also be evaluated. A cost-consequence analysis will describe the costs and health outcomes. DISCUSSION: We expect to find a significant increase in self-efficacy, goal attainment and quality of life and lower levels of psychological complaints (depression, anxiety and stress) in the intervention group, compared with the control group. If such effects are found, the program could provide accessible care to future generations of early-stage dementia caregivers and increase dementia care efficiency. TRIAL REGISTRATION: Dutch trial register NTR4748 .

Breen, S., Ritchie, D., Schofield, P., et al. (2015). "The Patient Remote Intervention and Symptom Management System (PRISMS) - a Telehealth- mediated intervention enabling real-time monitoring of chemotherapy side-effects in patients with haematological malignancies: study protocol for a randomised controlled trial." *Trials* **16**: 472.

BACKGROUND: Outpatient chemotherapy is a core treatment for haematological malignancies; however, its toxicities frequently lead to distressing/potentially life-threatening side-effects (neutropenia/infection, nausea/vomiting, mucositis, constipation/diarrhoea, fatigue). Early detection/management of side-effects is vital to improve patient outcomes, decrease morbidity and limit lengthy/costly hospital admissions. The ability to capture patient-reported health data in real-time, is regarded as the 'gold-standard' to allow rapid clinical decision-making/intervention. This paper presents the protocol for a Phase 3 multi-site randomised controlled trial evaluating a novel nurse-led Telehealth intervention for remote monitoring/management of chemotherapy side-effects in Australian haematological cancer patients. METHODS/DESIGN: Two hundred and twenty-two patients will be recruited from two hospitals. Eligibility criteria include: diagnosis of chronic lymphocytic leukaemia/Hodgkin's/non-Hodgkin's lymphoma; aged ≥ 18 years; receiving ≥ 2 cycles chemotherapy. Patients will be randomised 1:1 to either the control or intervention arm with stratification by diagnosis, chemotherapy toxicity (high versus low), receipt of previous chemotherapy and hospital. Patients allocated to the control arm will receive 'Usual Care' whilst those allocated to the intervention will receive the intervention in addition to 'Usual Care'. Intervention patients will be provided with a computer tablet and software prompting twice-daily completion of physical/emotional scales for up to four chemotherapy cycles. Should patient data exceed pre-determined limits an Email alert is delivered to the treatment team, prompting nurses to view patient data, and contact the patient to provide clinical intervention. In addition, six scheduled nursing interventions will be completed to educate/support patients in use of the software. Patient outcomes will be measured cyclically (midpoint and end of cycles) via pen-and-paper self-report alongside review of the patient medical record. The primary outcome is burden due to nausea, mucositis, constipation and fatigue. Secondary outcomes include: burden due to vomiting and diarrhoea; psychological distress; ability to self-manage health; level of cancer information/support needs and; utilisation of health services. Analyses will be intention-to-treat. A cost-effectiveness analysis is planned. DISCUSSION: This trial is the first in the world to test a remote monitoring/management intervention for adult haematological cancer patients receiving chemotherapy. Future use of such interventions have the potential to improve patient outcomes/safety and decrease health care costs by enabling early

detection/clinical intervention. TRIAL REGISTRATION: ACTRN12614000516684 . Date registered: 12 March 2014 (registered retrospectively).

Brooks, E., Turvey, C. et Augusterfer, E. F. (2013). "Provider barriers to telemental health: obstacles overcome, obstacles remaining." Telemed J E Health **19**(6): 433-437.

Many providers are hesitant to use telemental health technologies. When providers are queried, various barriers are presented, such as the clinician's skepticism about the effectiveness of telemental health (TMH), viewing telehealth technologies as inconvenient, or reporting difficulties with medical reimbursement. Provider support for TMH is critical to its diffusion because clinicians often serve as the initial gatekeepers to telehealth implementation and program success. In this article, we address provider concerns in three broad domains: (1) personal barriers, (2) clinical workflow and technology barriers, and (3) licensure, credentialing, and reimbursement barriers. We found evidence that, although many barriers have been discussed in the literature for years, advancements in TMH have rapidly reduced obstacles for its use. Improvements include extensive opportunities for training, a growing evidence base supporting positive TMH outcomes, and transformations in technologies that improve provider convenience and transmission quality. Recommendations for further change are discussed within each domain. In particular, it is important to grow and disseminate data underscoring the promise and effectiveness of TMH, integrate videoconferencing capabilities into electronic medical record platforms, expand TMH reimbursement, and modify licensure standards.

Cassimatis, M. et Kavanagh, D. J. (2012). "Effects of type 2 diabetes behavioural telehealth interventions on glycaemic control and adherence: a systematic review." J Telemed Telecare **18**(8): 447-450.

We reviewed the effect of behavioural telehealth interventions on glycaemic control and diabetes self-management in patients with type 2 diabetes. The databases CINAHL, Medline and psychINFO were searched in August 2012. Journal articles were selected that had been published in English with a randomized controlled trial design using a usual care comparison group, and in which the primary intervention component was delivered by telehealth. Relevant outcome measures were glycaemic control and one or more of the following diabetes self-care areas: diet, physical activity, blood glucose self-monitoring (BGSM) or medication adherence. Interventions were excluded if they were primarily based on telemonitoring. The search retrieved 1027 articles, from which 49 were selected based on their title and abstract. Fourteen articles (reporting 13 studies) met the eligibility criteria for inclusion. Four studies reported significant improvements in glycaemic control. Five of eight studies on dietary adherence reported significant treatment effects, as did five of eight on physical activity, four of nine on blood glucose self-monitoring, and three of eight on medication adherence. Overall, behavioural telehealth interventions show promise in improving the diabetes self-care and glycaemic control of people with type 2 diabetes.

Chaudhuri, S., Thompson, H. et Demiris, G. (2014). "Fall detection devices and their use with older adults: a systematic review." J Geriatr Phys Ther **37**(4): 178-196.

BACKGROUND: Falls represent a significant threat to the health and independence of adults aged 65 years and older. As a wide variety and large number of passive monitoring systems are currently and increasingly available to detect when individuals have fallen, there is a need to analyze and synthesize the evidence regarding their ability to accurately detect falls to determine which systems are most effective. OBJECTIVES: The purpose of this literature review is to systematically assess the current state of design and implementation of fall-

detection devices. This review also examines to what extent these devices have been tested in the real world as well as the acceptability of these devices to older adults. DATA SOURCES: A systematic literature review was conducted in PubMed, CINAHL, EMBASE, and PsycINFO from their respective inception dates to June 25, 2013. STUDY ELIGIBILITY CRITERIA AND INTERVENTIONS: Articles were included if they discussed a project or multiple projects involving a system with the purpose of detecting a fall in adults. It was not a requirement for inclusion in this review that the system targets persons older than 65 years. Articles were excluded if they were not written in English or if they looked at fall risk, fall detection in children, fall prevention, or a personal emergency response device. STUDY APPRAISAL AND SYNTHESIS METHODS: Studies were initially divided into those using sensitivity, specificity, or accuracy in their evaluation methods and those using other methods to evaluate their devices. Studies were further classified into wearable devices and nonwearable devices. Studies were appraised for inclusion of older adults in sample and if evaluation included real-world settings. RESULTS: This review identified 57 projects that used wearable systems and 35 projects using nonwearable systems, regardless of evaluation technique. Nonwearable systems included cameras, motion sensors, microphones, and floor sensors. Of the projects examining wearable systems, only 7.1% reported monitoring older adults in a real-world setting. There were no studies of nonwearable devices that used older adults as subjects in either a laboratory or a real-world setting. In general, older adults appear to be interested in using such devices although they express concerns over privacy and understanding exactly what the device is doing at specific times. LIMITATIONS: This systematic review was limited to articles written in English and did not include gray literature. Manual paper screening and review processes may have been subject to interpretive bias. CONCLUSIONS AND IMPLICATIONS OF KEY FINDINGS: There exists a large body of work describing various fall-detection devices. The challenge in this area is to create highly accurate unobtrusive devices. From this review it appears that the technology is becoming more able to accomplish such a task. There is a need now for more real-world tests as well as standardization of the evaluation of these devices.

Clark, R. A. (2018). "Telehealth in the Elderly with Chronic Heart Failure: What Is the Evidence?" Stud Health Technol Inform **246**: 18-23.

BACKGROUND: In a series of studies over the past decade we have measured the effectiveness of telehealth for elderly heart failure patients (>70 years) on rehospitalisation, mortality, adherence, satisfaction, cost effectiveness, health related quality of life, age and types of technology. METHODS: Evidence has been derived from a Cochrane systematic review and meta-analysis (1 original and 2 updates: 2007-2016), two sub-analysis of this data and a large NHMRC funded multicentre randomised controlled trial (CHAT study 2010). RESULTS: Within the studies included in the meta-analysis the mean age was 70 or more years in eight of the 16 (n=2,659/5,613; 47%) involving structured telephone support studies and four of the 11 (n=894/2,710; 33%) Telemonitoring studies. Structured telephone support (RR 0.80; 95% CI=0.63-1.00) and Telemonitoring (RR 0.56; 95% CI=0.41-0.76) interventions reduced mortality. Structured telephone support interventions reduced heart failure-related hospitalizations (RR 0.81; 95% CI=0.67-0.99). Four different types of non-invasive remote monitoring technologies were identified, including structured telephone calls, videophone, interactive voice response devices, and Telemonitoring. Structured telephone calls and Telemonitoring were effective in reducing the risk of all-cause mortality (relative risk [RR]=0.87; 95% confidence interval [CI], 0.75-1.01; p=0.06; and RR=0.62; 95% CI, 0.50-0.77; p<0.0001, respectively) and heart failure-related hospitalizations (RR=0.77; 95% CI, 0.68-0.87; p<0.001; and RR=0.75; 95% CI, 0.63-0.91; p=0.003, respectively). Videophone and interactive voice response technologies were not effective. Only 3% of this elderly group (mean age 74.7+/-9.3 years) were unable to learn or competently use the technology.

Adherence was reported between 55.1% and 98.5%. Participant satisfaction with Telehealth was reported between 76% and 97%. CONCLUSION: These studies show that elderly patients can adapt quickly to telehealth, find its use an acceptable part of their healthcare routine, and are able to maintain good adherence for at least 12 months. These findings support the use of telehealth as part of a comprehensive chronic heart failure management programme. [goes here.](#)

Conway, A., Inglis, S. C. et Clark, R. A. (2014). "Effective technologies for noninvasive remote monitoring in heart failure." *Telemed J E Health* **20**(6): 531-538.

BACKGROUND: Trials of new technologies to remotely monitor for signs and symptoms of worsening heart failure are continually emerging. The extent to which technological differences impact the effectiveness of noninvasive remote monitoring for heart failure management is unknown. This study examined the effect of specific technology used for noninvasive remote monitoring of people with heart failure on all-cause mortality and heart failure-related hospitalizations. **MATERIALS AND METHODS:** A subanalysis of a large systematic review and meta-analysis was conducted. Studies were stratified according to the specific type of technology used, and separate meta-analyses were performed. Four different types of noninvasive remote monitoring technologies were identified, including structured telephone calls, videophone, interactive voice response devices, and telemonitoring. **RESULTS:** Only structured telephone calls and telemonitoring were effective in reducing the risk of all-cause mortality (relative risk [RR]=0.87; 95% confidence interval [CI], 0.75-1.01; $p=0.06$; and RR=0.62; 95% CI, 0.50-0.77; $p<0.0001$, respectively) and heart failure-related hospitalizations (RR=0.77; 95% CI, 0.68-0.87; $p<0.001$; and RR=0.75; 95% CI, 0.63-0.91; $p=0.003$, respectively). More research data are required for videophone and interactive voice response technologies. **CONCLUSIONS:** This subanalysis identified that only two of the four specific technologies used for noninvasive remote monitoring in heart failure improved outcomes. When results of studies that involved these disparate technologies were combined in previous meta-analyses, significant improvements in outcomes were identified. As such, this study has highlighted implications for future meta-analyses of randomized controlled trials focused on evaluating the effectiveness of remote monitoring in heart failure.

Cotie, L. M., Prince, S. A., Elliott, C. G., et al. (2018). "The effectiveness of eHealth interventions on physical activity and measures of obesity among working-age women: a systematic review and meta-analysis." *Obes Rev* **19**(10): 1340-1358.

Physical inactivity and obesity are modifiable risk factors for cardiovascular disease, particularly in women. eHealth interventions may increase physical activity and improve obesity-related outcomes among women. The objective of this study was to review the evidence of the effectiveness of eHealth interventions to increase moderate-to-vigorous physical activity among working-age women. The secondary objective was to examine their effectiveness on improving obesity-related outcomes. A comprehensive search strategy was developed for eight electronic databases; through July 2016. All studies consisting of >80% women of working-age (18-65 years) in high income countries were included. Multiple unblinded reviewers determined study eligibility and extracted data. Risk of bias was evaluated using the Cochrane Risk of Bias Tool and data quality using the Grading of Recommendations Assessment, Development and Evaluation approach. Data were pooled using a random-effects model. Sixty studies were included in the review of which 20 were in the meta-analysis. The meta-analysis demonstrated eHealth interventions improved moderate-to-vigorous physical activity (standard mean difference = 1.13, 95% confidence interval: 0.58, 1.68, $P < 0.0001$); an increase of ~25 min week⁻¹. No changes were observed

in obesity-related outcomes; waist circumference ($P = 0.06$), body mass ($P = 0.05$) and body mass index ($P = 0.35$). eHealth interventions are effective at increasing min week(-1) of moderate-to-vigorous physical activity among working-age women from high income countries.

Cox, A., Lucas, G., Marcu, A., et al. (2017). "Cancer Survivors' Experience With Telehealth: A Systematic Review and Thematic Synthesis." *J Med Internet Res* **19**(1): e11.

BACKGROUND: Net survival rates of cancer are increasing worldwide, placing a strain on health service provision. There is a drive to transfer the care of cancer survivors-individuals living with and beyond cancer-to the community and encourage them to play an active role in their own care. Telehealth, the use of technology in remote exchange of data and communication between patients and health care professionals (HCPs), is an important contributor to this evolving model of care. Telehealth interventions are "complex," and understanding patient experiences of them is important in evaluating their impact. However, a wider view of patient experience is lacking as qualitative studies detailing cancer survivor engagement with telehealth are yet to be synthesized. **OBJECTIVE:** To systematically identify, appraise, and synthesize qualitative research evidence on the experiences of adult cancer survivors participating in telehealth interventions, to characterize the patient experience of telehealth interventions for this group. **METHODS:** Medline (PubMed), PsychINFO, Cumulative Index for Nursing and Allied Health Professionals (CINAHL), Embase, and Cochrane Central Register of Controlled Trials were searched on August 14, 2015, and March 8, 2016, for English-language papers published between 2006 and 2016. Inclusion criteria were as follows: adult cancer survivors aged 18 years and over, cancer diagnosis, experience of participating in a telehealth intervention (defined as remote communication or remote monitoring with an HCP delivered by telephone, Internet, or hand-held or mobile technology), and reporting qualitative data including verbatim quotes. An adapted Critical Appraisal Skill Programme (CASP) checklist for qualitative research was used to assess paper quality. The results section of each included article was coded line by line, and all papers underwent inductive analysis, involving comparison, reexamination, and grouping of codes to develop descriptive themes. Analytical themes were developed through an iterative process of reflection on, and interpretation of, the descriptive themes within and across studies. **RESULTS:** Across the 22 included papers, 3 analytical themes emerged, each with 3 descriptive subthemes: (1) influence of telehealth on the disrupted lives of cancer survivors (convenience, independence, and burden); (2) personalized care across physical distance (time, space, and the human factor); and (3) remote reassurance-a safety net of health care professional connection (active connection, passive connection, and slipping through the net). Telehealth interventions represent a convenient approach, which can potentially minimize treatment burden and disruption to cancer survivors' lives. Telehealth interventions can facilitate an experience of personalized care and reassurance for those living with and beyond cancer; however, it is important to consider individual factors when tailoring interventions to ensure engagement promotes benefit rather than burden. **CONCLUSIONS:** Telehealth interventions can provide cancer survivors with independence and reassurance. Future telehealth interventions need to be developed iteratively in collaboration with a broad range of cancer survivors to maximize engagement and benefit.

Cruz, J., Brooks, D. et Marques, A. (2014). "Home telemonitoring effectiveness in COPD: a systematic review." *Int J Clin Pract* **68**(3): 369-378.

OBJECTIVES: To provide a systematic review of the effectiveness of home telemonitoring to reduce healthcare utilisation and improve health-related outcomes of patients with chronic obstructive pulmonary disease (COPD). **METHODS:** An electronic literature search in Medline,

Embase, B-on and Web of Science was conducted from June to August 2012 and updated until July 2013, using the following keywords: [tele(-)monitoring or tele(-)health or tele(-)homecare or tele(-)care or tele-home health or home monitoring] and [Chronic Obstructive Pulmonary Disease or COPD]. Randomised and non-randomised controlled trials evaluating home telemonitoring interventions in COPD were included. A meta-analysis using risk ratio (RR) and standardised mean difference (SMD) was conducted for healthcare utilisation (hospitalisations, length of stay, emergency department visits) and associated costs, and health-related outcomes [mortality, exacerbations and health-related quality of life (HRQOL)]. RESULTS: Nine articles were included. Significant differences were found for hospitalisation rates (RR = 0.72; 95% CI = 0.53-0.98; p = 0.034); however, no differences in the other healthcare utilisation outcomes were observed. There was a trend to reduced healthcare costs in the telemonitoring group. In two studies, this intervention was associated with a reduced number of exacerbations (p < 0.05) and a significant increase in HRQOL (SMD = -0.53; 95% CI = -0.97- -0.09; p = 0.019). DISCUSSION AND CONCLUSIONS: Home telemonitoring appears to have a positive effect in reducing respiratory exacerbations and hospitalisations and improving quality of life. However, the evidence of its benefits is still limited and further research is needed to assess the effectiveness of home telemonitoring in COPD management, as there are still few studies in this area.

Cui, M., Wu, X., Mao, J., et al. (2016). "T2DM Self-Management via Smartphone Applications: A Systematic Review and Meta-Analysis." *PLoS One* **11**(11): e0166718.

BACKGROUND: Mobile health interventions (mHealth) based on smartphone applications (apps) are promising tools to help improve diabetes care and self-management; however, more evidence on the efficacy of mHealth in diabetes care is needed. The objective of this study was to conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) assessing the effect of mHealth apps on changes in hemoglobin A1c (HbA1c), blood glucose, blood pressure, serum lipids, and body weight in type 2 diabetes mellitus (T2DM) patients. METHODS: Two independent reviewers searched three online databases (PubMed, the Cochrane Library, and EMBASE) to identify relevant studies published between January 2005 and June 2016. Of the 2,596 articles retrieved, 13 RCTs were included. We used random effects model to estimate the pooled results. RESULTS: Thirteen studies were selected for the systematic review, six of which with data available containing 1,022 patients were included for the meta-analysis. There was a moderate effect on glycemic control after the mHealth app-based interventions. The overall effect on HbA1c shown as mean difference (MD) was -0.40% (-4.37 mmol/mol) (95% confidence interval [CI] -0.69 to -0.11% [-7.54 to -1.20 mmol/mol]; p = 0.007) and standardized mean differences (SMD) was -0.40% (-4.37 mmol/mol) (95% confidence interval [CI] -0.69 to -0.10% [-7.54 to -1.09 mmol/mol]; p = 0.008). A subgroup analysis showed a similar effect with -0.33% (-3.61 mmol/mol) (95% CI -0.59 to -0.06% [-6.45 to -0.66 mmol/mol]; p = 0.02) in MD and -0.38% (-4.15 mmol/mol) (95% CI -0.71 to -0.05% [-7.76 to -0.55 mmol/mol]; p = 0.02) in SMD in studies where patients' baseline HbA1c levels were less than 8.0%. No effects of mHealth app interventions were found on blood pressure, serum lipids, or weight. Assessment of overall study quality and publication bias demonstrated a low risk of bias among the six studies. CONCLUSIONS: Smartphone apps offered moderate benefits for T2DM self-management. However, more research with valid study designs and longer follow-up is needed to evaluate the impact of mHealth apps for diabetes care and self-management.

Darling, K. E. et Sato, A. F. (2017). "Systematic Review and Meta-Analysis Examining the Effectiveness of Mobile Health Technologies in Using Self-Monitoring for Pediatric Weight Management." *Child Obes* **13**(5): 347-355.

BACKGROUND: Pediatric obesity is a public health concern related to multiple negative physical and psychosocial problems. While behavioral weight control (BWC) interventions are generally effective in decreasing pediatric weight status, these interventions are not able to reach the third of U.S. children currently classified as overweight or obese. **METHOD:** This review and meta-analysis examined the overall effectiveness of mobile health (mHealth) technologies employing self-monitoring, a central component of change within BWC, to decrease pediatric weight status. **RESULTS:** Overall, a small, but significant overall effect size ($d = 0.42$) was found with the inclusion of nine eligible studies examining the effect on weight status. However, the quality of studies included within this weight status meta-analysis was weak, therefore limiting the interpretability of results. Analyses were also conducted examining the effect of mHealth technologies employing self-monitoring on secondary behavioral outcomes of physical activity and diet. Results indicated a small to medium, but nonsignificant effect ($d = 0.41$; four samples) on physical activity and a small, but significant effect on diet ($d = 0.10$; eight samples). **CONCLUSIONS:** Overall, the articles included in behavioral outcomes were of generally moderate quality. More work is needed to better identify the utility of mHealth and specific treatment components (such as self-monitoring), for pediatric weight management.

Davis, M. M., Freeman, M., Kaye, J., et al. (2014). "A systematic review of clinician and staff views on the acceptability of incorporating remote monitoring technology into primary care." *Telemed J E Health* **20**(5): 428-438.

OBJECTIVE: Remote monitoring technology (RMT) may enhance healthcare quality and reduce costs. RMT adoption depends on perceptions of the end-user (e.g., patients, caregivers, healthcare providers). We conducted a systematic review exploring the acceptability and feasibility of RMT use in routine adult patient care, from the perspectives of primary care clinicians, administrators, and clinic staff. **MATERIALS AND METHODS:** We searched the databases of Medline, IEEE Xplore, and Compendex for original articles published from January 1996 through February 2013. We manually screened bibliographies of pertinent studies and consulted experts to identify English-language studies meeting our inclusion criteria. **RESULTS:** Of 939 citations identified, 15 studies reported in 16 publications met inclusion criteria. Studies were heterogeneous by country, type of RMT used, patient and provider characteristics, and method of implementation and evaluation. Clinicians, staff, and administrators generally held positive views about RMTs. Concerns emerged regarding clinical relevance of RMT data, changing clinical roles and patterns of care (e.g., reduced quality of care from fewer patient visits, overtreatment), insufficient staffing or time to monitor and discuss RMT data, data incompatibility with a clinic's electronic health record (EHR), and unclear legal liability regarding response protocols. **CONCLUSIONS:** This small body of heterogeneous literature suggests that for RMTs to be adopted in primary care, researchers and developers must ensure clinical relevance, support adequate infrastructure, streamline data transmission into EHR systems, attend to changing care patterns and professional roles, and clarify response protocols. There is a critical need to engage end-users in the development and implementation of RMT.

de la Torre Diez, I., Garcia-Zapirain, B., Mendez-Zorrilla, A., et al. (2016). "Monitoring and Follow-up of Chronic Heart Failure: a Literature Review of eHealth Applications and Systems." *J Med Syst* **40**(7): 179.

In developed countries heart failure is one of the most important causes of death, followed closely by strokes and other cerebrovascular diseases. It is one of the major healthcare issues in terms of increasing number of patients, rate of hospitalizations and costs. The main aim of this paper is to present telemedicine applications for monitoring and follow-up of heart

failure and to show how these systems can help reduce costs of administering heart failure. The search for e-health applications and systems in the field of telemonitoring of heart failure was pursued in IEEE Xplore, Science Direct, PubMed and Scopus systems between 2005 and the present time. This search was conducted between May and June 2015, and the articles deemed to be of most interest about treatment, prevention, self-empowerment and stabilization of patients were selected. Over 100 articles about telemonitoring of heart failure have been found in the literature reviewed since 2005, although the most interesting ones have been selected from the scientific standpoint. Many of them show that telemonitoring of patients with a high risk of heart failure is a measure that might help to reduce the risk of suffering from the disease. Following the review conducted, it can be stated that via the research articles analysed that telemonitoring systems can help to reduce the costs of administering heart failure and result in less re-hospitalization of patients.

Dennis, S. M., Harris, M., Lloyd, J., et al. (2013). "Do people with existing chronic conditions benefit from telephone coaching? A rapid review." *Aust Health Rev* **37**(3): 381-388.

OBJECTIVE: To examine the effectiveness of telephone-based coaching services for the management of patients with chronic diseases. **METHODS:** A rapid scoping review of the published peer reviewed literature, using Medline, Embase, CINAHL, PsychNet and Scopus. We included studies involving people aged 18 years or over with one or more of the following chronic conditions: type 2 diabetes, congestive cardiac failure, coronary artery disease, chronic obstructive pulmonary disease and hypertension. Patients were identified as having multi-morbidity if they had an index chronic condition plus one or more other chronic condition. To be included in this review, the telephone coaching had to involve two-way conversations by telephone or video phone between a patient and a provider. Behaviour change, goal setting and empowerment are essential features of coaching. **RESULTS:** The review found 1756 papers, which was reduced to 30 after screening and relevance checks. Most coaching services were planned, as opposed to reactive, and targeted patients with complex needs who had one or more chronic disease. Several studies reported improvements in health behaviour, self-efficacy, health status and satisfaction with the service. More than one-third of the papers targeted vulnerable people and telephone coaching was found to be effective for these people. **CONCLUSIONS:** Telephone coaching for people with chronic conditions can improve health behaviour, self-efficacy and health status. This is especially true for vulnerable populations who had difficulty accessing health services. There is less evidence for improvements in quality of life and patient satisfaction with the service. The evidence for improvements in health service use was limited. This rapid scoping review found that telephone-based coaching can enhance the management of chronic disease, especially for vulnerable groups. Further work is needed to identify what models of telephone coaching are most effective according to patients' level of risk and co-morbidity. What is known about the topic? With the increasing prevalence of chronic diseases more demands are being made of limited health services and resources. Telephone health coaching for people with or at risk of chronic diseases is seen as a means of supporting people to manage their health and reducing the burden on the healthcare system. What does this paper add? Telephone coaching interventions were effective for vulnerable people with chronic disease(s). Often the vulnerable populations had worse control of their chronic condition at baseline and demonstrated the greatest improvement compared with those with better control at baseline. Planned (i.e. weekly or monthly telephone calls to support the patients with chronic disease) and unscripted telephone coaching interventions appear to be most effective for improving self-management skills in people from vulnerable groups: the planned telephone coaching services had the advantage of regular contact and helping people develop their skills over time, whereas the unscripted aspect allowed the coach to tailor support to the patient's individual needs. What are the implications for practitioners?

Telephone coaching is an effective means of supporting people with chronic diseases to manage their own health. Further work is needed to embed telephone coaching within existing services. Good linkages with the patient's general practitioner are important. This might be a regular report, updates via the patient e-health record, or provision for contact if a problem is identified or linking to the patient e-health record.

Duff, O. M., Walsh, D. M., Furlong, B. A., et al. (2017). "Behavior Change Techniques in Physical Activity eHealth Interventions for People With Cardiovascular Disease: Systematic Review." *J Med Internet Res* **19**(8): e281.

BACKGROUND: Cardiovascular disease (CVD) is the leading cause of premature death and disability in Europe, accounting for 4 million deaths per year and costing the European Union economy almost euro196 billion annually. There is strong evidence to suggest that exercise-based secondary rehabilitation programs can decrease the mortality risk and improve health among patients with CVD. Theory-informed use of behavior change techniques (BCTs) is important in the design of cardiac rehabilitation programs aimed at changing cardiovascular risk factors. Electronic health (eHealth) is the use of information and communication technologies (ICTs) for health. This emerging area of health care has the ability to enhance self-management of chronic disease by making health care more accessible, affordable, and available to the public. However, evidence-based information on the use of BCTs in eHealth interventions is limited, and particularly so, for individuals living with CVD. **OBJECTIVE:** The aim of this systematic review was to assess the application of BCTs in eHealth interventions designed to increase physical activity (PA) in CVD populations. **METHODS:** A total of 7 electronic databases, including EBSCOhost (MEDLINE, PsycINFO, Academic Search Complete, SPORTDiscus with Full Text, and CINAHL Complete), Scopus, and Web of Science (Core Collection) were searched. Two authors independently reviewed references using the software package Covidence (Veritas Health Innovation). The reviewers met to resolve any discrepancies, with a third independent reviewer acting as an arbitrator when required. Following this, data were extracted from the papers that met the inclusion criteria. Bias assessment of the studies was carried out using the Cochrane Collaboration's tool for assessing the risk of bias within Covidence; this was followed by a narrative synthesis. **RESULTS:** Out of the 987 studies that were identified, 14 were included in the review. An additional 9 studies were added following a hand search of review paper references. The average number of BCTs used across the 23 studies was 7.2 (range 1-19). The top three most frequently used BCTs included information about health consequences (78%, 18/23), goal setting (behavior; 74%, 17/23), and joint third, self-monitoring of behavior and social support (practical) were included in 11 studies (48%, 11/23) each. **CONCLUSIONS:** This systematic review is the first to investigate the use of BCTs in PA eHealth interventions specifically designed for people with CVD. This research will have clear implications for health care policy and research by outlining the BCTs used in eHealth interventions for chronic illnesses, in particular CVD, thereby providing clear foundations for further research and developments in the area.

Emami, E., Kadoch, N., Homayounfar, S., et al. (2017). "Patient satisfaction with E-Oral Health care in rural and remote settings: a systematic review protocol." *Syst Rev* **6**(1): 174.

BACKGROUND: Individuals living in rural and remote settings face oral health problems and access-to-care barriers due to the shortage of oral health care providers in these areas, geographic remoteness, lack of appropriate infrastructure and lower socio-economic status. E-Oral Health technology could mitigate these barriers by providing the delivery of some aspects of health care and exchange of information across geographic distances. This review will systematically evaluate the literature on patient satisfaction with received E-Oral Health

care in rural and remote communities. **METHODS:** This systematic review will include interventional and observational studies in which E-Oral Health technology is used as an intervention in rural and remote communities of any country worldwide. Conventional oral health care will be used as a comparator when provided. Patient satisfaction with received E-Oral Health care will be considered as a primary outcome for this review. Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE and Global Health will be searched using a comprehensive search strategy. Two review authors will independently screen results to identify potentially eligible studies and independently extract the data from the included studies. A third author will resolve any discrepancies between reviewers. Two independent researchers will assess the risk of bias and the Grading of Recommendations Assessment, Development, and Evaluation. **DISCUSSION:** The potential implications and benefits of E-Oral Health care can inform policymakers and health care professionals to take advantage of this technology to address health care challenges in these areas. **SYSTEMATIC REVIEW REGISTRATION:** PROSPERO CRD42016039942 .

Farnia, T., Jaulent, M.-C. et Steichen, O. (2018). "Evaluation Criteria of Noninvasive Telemonitoring for Patients With Heart Failure: Systematic Review." *J Med Internet Res* **20**(1): e16.

<http://www.jmir.org/2018/1/e16/>

<https://doi.org/10.2196/jmir.7873>

<http://www.ncbi.nlm.nih.gov/pubmed/29339348>

Background: Telemonitoring can improve heart failure (HF) management, but there is no standardized evaluation framework to comprehensively evaluate its impact. **Objective:** Our objectives were to list the criteria used in published evaluations of noninvasive HF telemonitoring projects, describe how they are used in the evaluation studies, and organize them into a consistent scheme. **Methods:** Articles published from January 1990 to August 2015 were obtained through MEDLINE, Web of Science, and EMBASE. Articles were eligible if they were original reports of a noninvasive HF telemonitoring evaluation study in the English language. Studies of implantable telemonitoring devices were excluded. Each selected article was screened to extract the description of the telemonitoring project and the evaluation process and criteria. A qualitative synthesis was performed. **Results:** We identified and reviewed 128 articles leading to 52 evaluation criteria classified into 6 dimensions: clinical, economic, user perspective, educational, organizational, and technical. The clinical and economic impacts were evaluated in more than 70% of studies, whereas the educational, organizational, and technical impacts were studied in fewer than 15%. User perspective was the most frequently covered dimension in the development phase of telemonitoring projects, whereas clinical and economic impacts were the focus of later phases. **Conclusions:** Telemonitoring evaluation frameworks should cover all 6 dimensions appropriately distributed along the telemonitoring project lifecycle. Our next goal is to build such a comprehensive evaluation framework for telemonitoring and test it on an ongoing noninvasive HF telemonitoring project.

Farzandipour, M., Nabovati, E., Sharif, R., et al. (2017). "Patient Self-Management of Asthma Using Mobile Health Applications: A Systematic Review of the Functionalities and Effects." *Appl Clin Inform* **8**(4): 1068-1081.

Objective The aim of this systematic review was to summarize the evidence regarding the effects of mobile health applications (mHealth apps) for self-management outcomes in patients with asthma and to assess the functionalities of effective interventions. **Methods** We systematically searched Medline, Scopus, and the Cochrane Central Register of Controlled Trials. We included English-language studies that evaluated the effects of smartphone or tablet computer apps on self-management outcomes in asthmatic patients. **The characteristics of these studies, effects of interventions, and features of mHealth apps**

were extracted. Results A total of 10 studies met all the inclusion criteria. Outcomes that were assessed in the included studies were categorized into three groups (clinical, patient-reported, and economic). mHealth apps improved asthma control (five studies) and lung function (two studies) from the clinical outcomes. From the patient-reported outcomes, quality of life (three studies) was statistically significantly improved, while there was no significant impact on self-efficacy scores (two studies). Effects on economic outcomes were equivocal, so that the number of visits (in two studies) and admission and hospitalization-relevant outcomes (in one study) statistically significantly improved; and in four other studies, these outcomes did not improve significantly. mHealth apps features were categorized into seven categories (inform, instruct, record, display, guide, remind/alert, and communicate). Eight of the 10 mHealth apps included more than one functionality. Nearly all interventions had the functionality of recording user-entered data and half of them had the functionality of providing educational information and reminders to patients. Conclusion Multifunctional mHealth apps have good potential in the control of asthma and in improving the quality of life in such patients compared with traditional interventions. Further studies are needed to identify the effectiveness of these interventions on outcomes related to medication adherence and costs.

Feltner, C., Jones, C. D., Cene, C. W., et al. (2014). "Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis." *Ann Intern Med* **160**(11): 774-784.

BACKGROUND: Nearly 25% of patients hospitalized with heart failure (HF) are readmitted within 30 days. PURPOSE: To assess the efficacy, comparative effectiveness, and harms of transitional care interventions to reduce readmission and mortality rates for adults hospitalized with HF. DATA SOURCES: MEDLINE, Cochrane Library, CINAHL, ClinicalTrials.gov, and World Health Organization International Clinical Trials Registry Platform (1 January 1990 to late October 2013). STUDY SELECTION: Two reviewers independently selected randomized, controlled trials published in English reporting a readmission or mortality rate within 6 months of an index hospitalization. DATA EXTRACTION: One reviewer extracted data, and another checked accuracy. Two reviewers assessed risk of bias and graded strength of evidence (SOE). DATA SYNTHESIS: Forty-seven trials were included. Most enrolled adults with moderate to severe HF and a mean age of 70 years. Few trials reported 30-day readmission rates. At 30 days, a high-intensity home-visiting program reduced all-cause readmission and the composite end point (all-cause readmission or death; low SOE). Over 3 to 6 months, home-visiting programs and multidisciplinary heart failure (MDS-HF) clinic interventions reduced all-cause readmission (high SOE). Home-visiting programs reduced HF-specific readmission and the composite end point (moderate SOE). Structured telephone support (STS) interventions reduced HF-specific readmission (high SOE) but not all-cause readmissions (moderate SOE). Home-visiting programs, MDS-HF clinics, and STS interventions produced a mortality benefit. Neither telemonitoring nor primarily educational interventions reduced readmission or mortality rates. LIMITATIONS: Few trials reported 30-day readmission rates. Usual care was heterogeneous and sometimes not adequately described. CONCLUSION: Home-visiting programs and MDS-HF clinics reduced all-cause readmission and mortality; STS reduced HF-specific readmission and mortality. These interventions should receive the greatest consideration by systems or providers seeking to implement transitional care interventions for persons with HF. PRIMARY FUNDING SOURCE: Agency for Healthcare Research and Quality.

Fiorino, G., Allocca, M., Chaparro, M., et al. (2019). "'Quality of Care' Standards in Inflammatory Bowel Disease: A Systematic Review." *J Crohns Colitis* **13**(1): 127-137.

Background: Inflammatory bowel disease [IBD] includes chronic, disabling and progressive conditions that need a complex approach and management. Although several attempts have been made to standardize the care of IBD patients, no clear definitions of a global 'standard of care' are currently available. **Methods:** We performed a systematic review of the available literature, searching for all relevant data concerning three main domains of standards of quality of care in IBD patients: structure, process and outcomes. From the literature search, 2394 abstracts were retrieved, and 62 relevant papers were included in the final review. **Results:** Standards of quality of care in IBD include several aspects that can be summarized in three identified domains: structure, process and outcomes. The suggested structure of an IBD Unit includes a multi-disciplinary approach, effective referral processes, improved access using helplines, and departmental guidelines/pathways with identification of measurable quality indicators. Coordinated care models which incorporate a multi-disciplinary approach, structured clinical pathways or processes for the diagnosis, monitoring and treatment of IBD, fast-track recovery from IBD surgery, designated IBD clinics, virtual clinics and telemanagement are currently considered the main standards for process, although supporting data are limited. Several consensus statements on outcomes and quality indicators have been reported, focusing on outcomes in symptoms, function and quality of life restoration, survival and disease control, in addition to effective healthcare utilization. **Conclusions:** The results of this systematic review can provide the basis for general recommendations for standards of quality of care in IBD.

Firth, J., Torous, J., Nicholas, J., et al. (2017). "Can smartphone mental health interventions reduce symptoms of anxiety? A meta-analysis of randomized controlled trials." *J Affect Disord* **218**: 15-22.

BACKGROUND: Various psychological interventions are effective for reducing symptoms of anxiety when used alone, or as an adjunct to anti-anxiety medications. Recent studies have further indicated that smartphone-supported psychological interventions may also reduce anxiety, although the role of mobile devices in the treatment and management of anxiety disorders has yet to be established. **METHODS:** We conducted a systematic review and meta-analysis of all randomized clinical trials (RCTs) reporting the effects of psychological interventions delivered via smartphone on symptoms of anxiety (sub-clinical or diagnosed anxiety disorders). A systematic search of major electronic databases conducted in November 2016 identified 9 eligible RCTs, with 1837 participants. Random-effects meta-analyses were used to calculate the standardized mean difference (as Hedges' *g*) between smartphone interventions and control conditions. **RESULTS:** Significantly greater reductions in total anxiety scores were observed from smartphone interventions than control conditions ($g=0.325$, 95% C.I.=0.17-0.48, $p<0.01$), with no evidence of publication bias. Effect sizes from smartphone interventions were significantly greater when compared to waitlist/inactive controls ($g=0.45$, 95% C.I.=0.30-0.61, $p<0.01$) than active control conditions ($g=0.19$, 95% C.I.=0.07-0.31, $p=0.003$). **LIMITATIONS:** The extent to which smartphone interventions can match (or exceed) the efficacy of recognised treatments for anxiety has yet to be established. **CONCLUSIONS:** This meta-analysis shows that psychological interventions delivered via smartphone devices can reduce anxiety. Future research should aim to develop pragmatic methods for implementing smartphone-based support for people with anxiety, while also comparing the efficacy of these interventions to standard face-to-face psychological care.

Free, C., Phillips, G., Galli, L., et al. (2013). "The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review." *PLoS Med* **10**(1): e1001362.

BACKGROUND: Mobile technologies could be a powerful media for providing individual level support to health care consumers. We conducted a systematic review to assess the

effectiveness of mobile technology interventions delivered to health care consumers. METHODS AND FINDINGS: We searched for all controlled trials of mobile technology-based health interventions delivered to health care consumers using MEDLINE, EMBASE, PsycINFO, Global Health, Web of Science, Cochrane Library, UK NHS HTA (Jan 1990-Sept 2010). Two authors extracted data on allocation concealment, allocation sequence, blinding, completeness of follow-up, and measures of effect. We calculated effect estimates and used random effects meta-analysis. We identified 75 trials. Fifty-nine trials investigated the use of mobile technologies to improve disease management and 26 trials investigated their use to change health behaviours. Nearly all trials were conducted in high-income countries. Four trials had a low risk of bias. Two trials of disease management had low risk of bias; in one, antiretroviral (ART) adherence, use of text messages reduced high viral load (>400 copies), with a relative risk (RR) of 0.85 (95% CI 0.72-0.99), but no statistically significant benefit on mortality (RR 0.79 [95% CI 0.47-1.32]). In a second, a PDA based intervention increased scores for perceived self care agency in lung transplant patients. Two trials of health behaviour management had low risk of bias. The pooled effect of text messaging smoking cessation support on biochemically verified smoking cessation was (RR 2.16 [95% CI 1.77-2.62]). Interventions for other conditions showed suggestive benefits in some cases, but the results were not consistent. No evidence of publication bias was demonstrated on visual or statistical examination of the funnel plots for either disease management or health behaviours. To address the limitation of the older search, we also reviewed more recent literature. CONCLUSIONS: Text messaging interventions increased adherence to ART and smoking cessation and should be considered for inclusion in services. Although there is suggestive evidence of benefit in some other areas, high quality adequately powered trials of optimised interventions are required to evaluate effects on objective outcomes.

Fu, H., McMahon, S. K., Gross, C. R., et al. (2017). "Usability and clinical efficacy of diabetes mobile applications for adults with type 2 diabetes: A systematic review." Diabetes Res Clin Pract **131**: 70-81.

OBJECTIVES: To assess the usability and clinical effectiveness of diabetes mobile applications (diabetes apps) developed for adults with type 2 diabetes. METHOD: A systematic review of the usability and effectiveness of diabetes apps was conducted. Searches were performed using MEDLINE, EMBASE, COMPENDEX, and IEEE XPLORÉ for articles published from January 1, 2011, to January 17, 2017. Search terms included: diabetes, mobile apps, and mobile health (mHealth). RESULTS: The search yielded 723 abstracts of which seven usability studies and ten clinical effectiveness studies met the inclusion criteria from 20 publications. Usability, as measured by satisfaction ratings from experts and patients, ranged from 38% to 80%. Usability problem ratings ranged from moderate to catastrophic. Top usability problems are multi-steps task, limited functionality and interaction, and difficult system navigation. Clinical effectiveness, measured by reductions in HbA1c, ranged from 0.15% to 1.9%. CONCLUSION: Despite meager satisfaction ratings and major usability problems, there is some limited evidence supporting the effectiveness of diabetes apps to improve glycemic control for adults with type 2 diabetes. Findings strongly suggest that efforts to improve user satisfaction, incorporate established principles of health behavior change, and match apps to user characteristics will increase the therapeutic impact of diabetes apps.

Gandapur, Y., Kianoush, S., Kelli, H. M., et al. (2016). "The role of mHealth for improving medication adherence in patients with cardiovascular disease: a systematic review." Eur Heart J Qual Care Clin Outcomes **2**(4): 237-244.

Cardiovascular disease is a leading cause of morbidity and mortality worldwide, and a key barrier to improved outcomes is medication non-adherence. The aim of this study is to review the role of mobile health (mHealth) tools for improving medication adherence in

patients with cardiovascular disease. We performed a systematic search for randomized controlled trials that primarily investigated mHealth tools for improving adherence to cardiovascular disease medications in patients with hypertension, coronary artery disease, heart failure, peripheral arterial disease, and stroke. We extracted and reviewed data on the types of mHealth tools used, preferences of patients and healthcare providers, the effect of the mHealth interventions on medication adherence, and the limitations of trials. We identified 10 completed trials matching our selection criteria, mostly with <100 participants, and ranging in duration from 1 to 18 months. mHealth tools included text messages, Bluetooth-enabled electronic pill boxes, online messaging platforms, and interactive voice calls. Patients and healthcare providers generally preferred mHealth to other interventions. All 10 studies reported that mHealth interventions improved medication adherence, though the magnitude of benefit was not consistently large and in one study was not greater than a telehealth comparator. Limitations of trials included small sample sizes, short duration of follow-up, self-reported outcomes, and insufficient assessment of unintended harms and financial implications. Current evidence suggests that mHealth tools can improve medication adherence in patients with cardiovascular diseases. However, high-quality clinical trials of sufficient size and duration are needed to move the field forward and justify use in routine care.

Gokalp, H. et Clarke, M. (2013). "Monitoring activities of daily living of the elderly and the potential for its use in telecare and telehealth: a review." *Telemed J E Health* **19**(12): 910-923.

OBJECTIVE: This review was designed to determine whether telemonitoring activities of daily living (ADL) of elderly people can improve quality of life and be beneficial to their healthcare. **MATERIALS AND METHODS:** Electronic databases were searched for studies that monitored ADL of elderly people and preferably measured some clinical outcomes such as ability to predict key events that require intervention and for studies that assessed perception of elderly people of such telemonitoring systems. The articles were reviewed and assessed independently by two reviewers. **RESULTS:** One hundred seventy-five unique studies were found. Sixty-seven of these were identified for potential inclusion, and 25 studies were finally included. Study characteristics, parameters monitored, outcomes, and problems encountered were summarized and discussed. The main focus was on the potential benefits of ADL monitoring on the care of elderly people. **CONCLUSIONS:** Although most studies reported on technical improvements in methods for detecting changes in ADL, few, if any, determined the benefits to the patient of telemonitoring for changes in ADL or correlation with any physiological changes. We propose sensor and system characteristics for improved user acceptance and deployment in a large-scale care plan. We present areas requiring further investigation.

Greenwood, D. A., Gee, P. M., Fatkin, K. J., et al. (2017). "A Systematic Review of Reviews Evaluating Technology-Enabled Diabetes Self-Management Education and Support." *J Diabetes Sci Technol* **11**(5): 1015-1027.

BACKGROUND: Since the introduction of mobile phones, technology has been increasingly used to enable diabetes self-management education and support. This timely systematic review summarizes how currently available technology impacts outcomes for people living with diabetes. **METHODS:** A systematic review of high quality review articles and meta analyses focused on utilizing technology in diabetes self-management education and support services was conducted. Articles were included if published between January 2013 and January 2017. **RESULTS:** Twenty-five studies were included for analysis. The majority evaluated the use of mobile phones and secure messaging. Most studies described healthy eating, being active and metabolic monitoring as the predominant self-care behaviors

evaluated. Eighteen of 25 reviews reported significant reduction in A1c as an outcome measure. Four key elements emerged as essential for improved A1c: (1) communication, (2) patient-generated health data, (3) education, and (4) feedback. CONCLUSION: Technology-enabled diabetes self-management solutions significantly improve A1c. The most effective interventions incorporated all the components of a technology-enabled self-management feedback loop that connected people with diabetes and their health care team using 2-way communication, analyzed patient-generated health data, tailored education, and individualized feedback. The evidence from this systematic review indicates that organizations, policy makers and payers should consider integrating these solutions in the design of diabetes self-management education and support services for population health and value-based care models. With the widespread adoption of mobile phones, digital health solutions that incorporate evidence-based, behaviorally designed interventions can improve the reach and access to diabetes self-management education and ongoing support.

Griffiths, S. E., Parsons, J., Naughton, F., et al. (2018). "Are digital interventions for smoking cessation in pregnancy effective? A systematic review and meta-analysis." *Health Psychol Rev* **12**(4): 333-356.

Smoking in pregnancy remains a global public health issue due to foetal health risks and potential maternal complications. The aims of this systematic review and meta-analysis were to explore: (1) whether digital interventions for pregnancy smoking cessation are effective, (2) the impact of intervention platform on smoking cessation, (3) the associations between specific Behaviour Change Techniques (BCTs) delivered within interventions and smoking cessation and (4) the association between the total number of BCTs delivered and smoking cessation. Systematic searches of 9 databases resulted in the inclusion of 12 published articles (n = 2970). The primary meta-analysis produced a sample-weighted odds ratio (OR) of 1.44 (95% CI 1.04-2.00, p = .03) in favour of digital interventions compared with comparison groups. Computer-based (OR = 3.06, 95% CI 1.28-7.33) and text-message interventions (OR = 1.59, 95% CI 1.07-2.38) were the most effective digital platform. Moderator analyses revealed seven BCTs associated with smoking cessation: information about antecedents; action planning; problem solving; goal setting (behaviour); review behaviour goals; social support (unspecified); and pros and cons. A meta-regression suggested that interventions using larger numbers of BCTs produced the greatest effects. This paper highlights the potential for digital interventions to improve rates of smoking cessation in pregnancy.

Hamilton, S. J., Mills, B., Birch, E. M., et al. (2018). "Smartphones in the secondary prevention of cardiovascular disease: a systematic review." *BMC Cardiovasc Disord* **18**(1): 25.

BACKGROUND: Cardiac Rehabilitation (CR) and secondary prevention are effective components of evidence-based management for cardiac patients, resulting in improved clinical and behavioural outcomes. Mobile health (mHealth) is a rapidly growing health delivery method that has the potential to enhance CR and heart failure management. We undertook a systematic review to assess the evidence around mHealth interventions for CR and heart failure management for service and patient outcomes, cost effectiveness with a view to how mHealth could be utilized for rural, remote and Indigenous cardiac patients. METHODS: A comprehensive search of databases using key terms was conducted for the years 2000 to August 2016 to identify randomised and non-randomised trials utilizing smartphone functionality and a model of care that included CR and heart failure management. Included studies were assessed for quality and risk of bias and data extraction was undertaken by two independent reviewers. RESULTS: Nine studies described a mix of mHealth interventions for CR (5 studies) and heart failure (4 studies) in the following categories: feasibility, utility and uptake studies; and randomised controlled trials. Studies

showed that mHealth delivery for CR and heart failure management is feasible with high rates of participant engagement, acceptance, usage, and adherence. Moreover, mHealth delivery of CR was as effective as traditional centre-based CR (TCR) with significant improvement in quality of life. Hospital utilization for heart failure patients showed inconsistent reductions. There was limited inclusion of rural participants. CONCLUSION: Mobile health delivery has the potential to improve access to CR and heart failure management for patients unable to attend TCR programs. Feasibility testing of culturally appropriate mHealth delivery for CR and heart failure management is required in rural and remote settings with subsequent implementation and evaluation into local health care services.

Hamine, S., Gerth-Guyette, E., Faulx, D., et al. (2015). "Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review." *J Med Internet Res* **17**(2): e52.

BACKGROUND: Adherence to chronic disease management is critical to achieving improved health outcomes, quality of life, and cost-effective health care. As the burden of chronic diseases continues to grow globally, so does the impact of non-adherence. Mobile technologies are increasingly being used in health care and public health practice (mHealth) for patient communication, monitoring, and education, and to facilitate adherence to chronic diseases management. OBJECTIVE: We conducted a systematic review of the literature to evaluate the effectiveness of mHealth in supporting the adherence of patients to chronic diseases management ("mAdherence"), and the usability, feasibility, and acceptability of mAdherence tools and platforms in chronic disease management among patients and health care providers. METHODS: We searched PubMed, Embase, and EBSCO databases for studies that assessed the role of mAdherence in chronic disease management of diabetes mellitus, cardiovascular disease, and chronic lung diseases from 1980 through May 2014. Outcomes of interest included effect of mHealth on patient adherence to chronic diseases management, disease-specific clinical outcomes after intervention, and the usability, feasibility, and acceptability of mAdherence tools and platforms in chronic disease management among target end-users. RESULTS: In all, 107 articles met all inclusion criteria. Short message service was the most commonly used mAdherence tool in 40.2% (43/107) of studies. Usability, feasibility, and acceptability or patient preferences for mAdherence interventions were assessed in 57.9% (62/107) of studies and found to be generally high. A total of 27 studies employed randomized controlled trial (RCT) methods to assess impact on adherence behaviors, and significant improvements were observed in 15 of those studies (56%). Of the 41 RCTs that measured effects on disease-specific clinical outcomes, significant improvements between groups were reported in 16 studies (39%). CONCLUSIONS: There is potential for mHealth tools to better facilitate adherence to chronic disease management, but the evidence supporting its current effectiveness is mixed. Further research should focus on understanding and improving how mHealth tools can overcome specific barriers to adherence.

Helsel, B. C., Williams, J. E., Lawson, K., et al. (2018). "Telemedicine and Mobile Health Technology Are Effective in the Management of Digestive Diseases: A Systematic Review." *Dig Dis Sci* **63**(6): 1392-1408.

BACKGROUND: Mobile applications and interactive websites are an increasingly used method of telemedicine, but their use lacks evidence in digestive diseases. AIM: This study aims to explore digestive disease studies that use telemedicine to effectively manage disease activity, help monitor symptoms, improve compliance to the treatment protocol, increase patient satisfaction, and enhance the patient-to-provider communication. METHODS: EBSCO,

PubMed, and Web of Science databases were searched using Medical Subject Headings and other keywords to identify studies that utilized telemedicine in patients with digestive disease. The PRISMA guidelines were used to identify 20 research articles that had data aligning with 4 common overlapping themes including, patient compliance (n = 13), patient satisfaction (n = 11), disease activity (n = 15), and quality of life (n = 13). The studies focused on digestive diseases including inflammatory bowel disease (n = 7), ulcerative colitis (n = 4), Crohn's Disease (n = 1), irritable bowel syndrome (n = 6), and colorectal cancer (n = 2). RESULTS: From the studies included in this systematic review, patient compliance and patient satisfaction ranged between 25.7-100% and 74-100%, respectively. Disease activity, measured by symptom severity scales and physiological biomarkers, showed improvements following telemedicine interventions in several, but not all, studies. Similar to disease activity, general and disease-specific quality of life showed improvements following telemedicine interventions in as little as 12 weeks in some studies. CONCLUSION: Telemedicine and mobile health technology may be effective in managing disease activity and improving quality of life in digestive diseases. Future studies should explore both gastrointestinal and gastroesophageal diseases using these types of interventions.

Hemsley, B., Georgiou, A., Carter, R., et al. (2016). "Use of the My Health Record by people with communication disability in Australia: A review to inform the design and direction of future research." *Him j.*

BACKGROUND: People with communication disability often struggle to convey their health information to multiple service providers and are at increased risk of adverse health outcomes related to the poor exchange of health information. OBJECTIVE: The purpose of this article was to (a) review the literature informing future research on the Australian personally controlled electronic health record, 'My Health Record' (MyHR), specifically to include people with communication disability and their family members or service providers, and (b) to propose a range of suitable methodologies that might be applied in research to inform training, policy and practice in relation to supporting people with communication disability and their representatives to engage in using MyHR. METHOD: The authors reviewed the literature and, with a cross-disciplinary perspective, considered ways to apply sociotechnical, health informatics, and inclusive methodologies to research on MyHR use by adults with communication disability. RESEARCH OUTCOMES: This article outlines a range of research methods suitable for investigating the use of MyHR by people who have communication disability associated with a range of acquired or lifelong health conditions, and their family members, and direct support workers. CONCLUSION: In planning the allocation of funds towards the health and well-being of adults with disabilities, both disability and health service providers must consider the supports needed for people with communication disability to use MyHR. There is an urgent need to focus research efforts on MyHR in populations with communication disability, who struggle to communicate their health information across multiple health and disability service providers. The design of studies and priorities for future research should be set in consultation with people with communication disability and their representatives.

Heynsbergh, N., Heckel, L., Botti, M., et al. (2018). "Feasibility, useability and acceptability of technology-based interventions for informal cancer carers: a systematic review." *BMC Cancer* **18**(1): 244.

BACKGROUND: Carers looking after someone with cancer often experience negative impacts on their own health. M-health interventions have been designed to provide information and support to patients and their carers. However, the effectiveness of technology-based interventions for carers is less well understood. The objectives were to assess the feasibility,

useability and acceptability of technology-based interventions among carers of people living with cancer. METHODS: A systematic search of the CINAHL, MEDLINE and PSYCINFO databases was performed using terms related to web-based interventions and smartphone applications, carers and cancer. Studies were included if a randomised controlled trial or pilot study was conducted, focused on adult carers looking after another adult with cancer and were published between January 2007-June 2017. Articles were excluded if they reported qualitative results only or were evaluating existing websites and applications. Feasibility was measured by attrition, recruitment rates and frequency of intervention use; useability was measured by the ease of intervention use and the role of features to minimise errors in use. Acceptability was measured by carers' perception of the appropriateness of the content and their ability to incorporate the intervention into their daily routines. RESULTS: Of the 729 articles, six articles met the inclusion criteria. Attrition ranged from 14% - 77%, recruitment rates from 20% - 66% and intervention useability varied across studies. Half of the studies implemented measures to improve useability. Overall, carers rated the content of the interventions as appropriate and reported improved knowledge and communication. Acceptability was further demonstrated as carers preferred the flexibility available with web-based interventions. CONCLUSIONS: Technology-based interventions are suitable for use among carers of people with cancer. Further research is required to fully assess the impact of technology as an information and support mechanism for carers.

Holl, F. et Swoboda, W. (2018). "Methods to Measure the Impact of mHealth Applications: Preliminary Results of a Scoping Review." *Stud Health Technol Inform* **251**: 285-288.

Important requirements for mHealth, the availability of devices and network connectivity have dramatically improved in the past years globally. mHealth applications are being developed at a rapid pace. But a thorough impact assessment is not routinely performed. We performed a scoping review to compile an overview of evaluation methods used to assess mHealth applications. Preliminary results are reported here, and a full scoping review is in preparation. Qualitative measurement of user experience is common. A number of studies measured the impact of the mHealth intervention on clinical outcomes. Few measured usability and end-user experience. Assessment of the impact on treatment process was rare and evaluations of cost and cost-effectiveness analyses are rarely ever done. An evaluation framework for mHealth interventions that includes disease-appropriate clinical outcome measures, use experience measure but also an economic component in form of cost comparison of the intervention with the standard of care should be developed.

Holtz, B. et Lauckner, C. (2012). "Diabetes management via mobile phones: a systematic review." *Telemed J E Health* **18**(3): 175-184.

BACKGROUND: This study sought to understand the most common uses and functions of mobile phones in monitoring and managing diabetes, their potential role in a clinical setting, and the current state of research in this area. METHODS: We identified peer-reviewed articles published between 2000 and 2010. Twenty-one articles were analyzed for this systematic literature review. RESULTS: The majority of studies examined the use of mobile phones from the patient's perspective. Subjects with type 1 diabetes were enrolled exclusively in over 50% of the studies. Seventy-one percent of the studies used a study-specific application, which had supplemental features in addition to text messaging. The outcomes assessed varied considerably across studies, but some positive trends were noted, such as improved self-efficacy, hemoglobin A1c, and self-management behaviors. CONCLUSIONS: The studies evaluated showed promise in using mobile phones to help people with diabetes manage their condition effectively. However, many of these studies lacked sufficient sample sizes or intervention lengths to determine whether the results might be

clinically or statistically significant. Future research should examine other key issues, such as provider perceptions, integration into a healthcare practice, and cost, which would provide important insight into the use of mobile phones for chronic disease management.

Huang, K., Liu, W., He, D., et al. (2015). "Telehealth interventions versus center-based cardiac rehabilitation of coronary artery disease: A systematic review and meta-analysis." *Eur J Prev Cardiol* **22**(8): 959-971.

BACKGROUND: Cardiac rehabilitation (CR) is an evidence-based recommendation for patients with coronary artery disease (CAD). However, CR is dramatically underutilized. Telehealth interventions have the potential to overcome barriers and may be an innovative model of delivering CR. This review aimed to determine the effectiveness of telehealth intervention delivered CR compared with center-based supervised CR. **METHOD:** Medline, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library and the Chinese BioMedical Literature Database (CBM), were searched to April 2014, without language restriction. Existing randomized controlled trials, reviews, relevant conference lists and gray literature were checked. Randomized controlled trials that compared telehealth intervention delivered CR with traditional center-based supervised CR in adults with CAD were included. Two reviewers selected studies and extracted data independently. Main clinical outcomes including clinical events, modifiable risk factors or other endpoints were measured. **RESULTS:** Fifteen articles reporting nine trials were reviewed, most of which recruited patients with myocardial infarction or revascularization. No statistically significant difference was found between telehealth interventions delivered and center-based supervised CR in exercise capacity (standardized mean difference (SMD) -0.01; 95% confidence interval (CI) -0.12-0.10), weight (SMD -0.13; 95% CI -0.30-0.05), systolic and diastolic blood pressure (mean difference (MD) -1.27; 95% CI -3.67-1.13 and MD 1.00; 95% CI -0.42-2.43, respectively), lipid profile, smoking (risk ratio (RR) 1.03; 95% CI 0.78-1.38), mortality (RR 1.15; 95% CI 0.61-2.19), quality of life and psychosocial state. **CONCLUSIONS:** Telehealth intervention delivered cardiac rehabilitation does not have significantly inferior outcomes compared to center-based supervised program in low to moderate risk CAD patients. Telehealth intervention offers an alternative deliver model of CR for individuals less able to access center-based cardiac rehabilitation. Choices should reflect preferences, anticipation, risk profile, funding, and accessibility to health service.

Huang, V. W., Reich, K. M. et Fedorak, R. N. (2014). "Distance management of inflammatory bowel disease: systematic review and meta-analysis." *World J Gastroenterol* **20**(3): 829-842.

AIM: To review the effectiveness of distance management methods in the management of adult inflammatory bowel disease (IBD) patients. **METHODS:** A systematic review and meta-analysis of randomized controlled trials comparing distance management and standard clinic follow-up in the management of adult IBD patients. Distance management intervention was defined as any remote management method in which there is a patient self-management component whereby the patient interacts remotely via a self-guided management program, electronic interface, or self-directs open access to clinic follow up. The search strategy included electronic databases (Medline, PubMed, CINAHL, The Cochrane Central Register of Controlled Trials, EMBASE, KtPlus, Web of Science, and SCOPUS), conference proceedings, and internet search for web publications. The primary outcome was the mean difference in quality of life, and the secondary outcomes included mean difference in relapse rate, clinic visit rate, and hospital admission rate. Study selection, data extraction, and risk of bias assessment were completed by two independent reviewers. **RESULTS:** The search strategy identified a total of 4061 articles, but only 6 randomized controlled trials met the inclusion and exclusion criteria for the systematic review and meta-analysis. Three trials involved

telemanagement, and three trials involved directed patient self-management and open access clinics. The total sample size was 1463 patients. There was a trend towards improved quality of life in distance management patients with an end IBDQ quality of life score being 7.28 (95%CI: -3.25-17.81) points higher than standard clinic follow-up. There was a significant decrease in the clinic visit rate among distance management patients mean difference -1.08 (95%CI: -1.60--0.55), but no significant change in relapse rate or hospital admission rate. CONCLUSION: Distance management of IBD significantly decreases clinic visit utilization, but does not significantly affect relapse rates or hospital admission rates.

Huang, Z., Tao, H., Meng, Q., et al. (2015). "Management of endocrine disease. Effects of telecare intervention on glycemic control in type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials." *Eur J Endocrinol* **172**(3): R93-101.

OBJECTIVE: To review the published literature on the effects of telecare intervention in patients with type 2 diabetes and inadequate glycemic control. DESIGN AND METHODS: A review of randomized controlled trials on telecare intervention in patients with type 2 diabetes, and a search of electronic databases such as The Cochrane Library, PubMed, EBSCO, CINAHL, Science Direct, Journal of Telemedicine and Telecare, and China National Knowledge Infrastructure (CNKI), were conducted from December 8 to 16, 2013. Two evaluators independently selected and reviewed the eligible studies. Changes in HbA1c, fasting plasma glucose (FPG), post-prandial plasma glucose (PPG), BMI, and body weight were analyzed. RESULTS: An analysis of 18 studies with 3798 subjects revealed that telecare significantly improved the management of diabetes. Mean HbA1c values were reduced by -0.54 (95% CI, -0.75 to -0.34; P<0.05), mean FPG levels by -9.00 mg/dl (95% CI, -17.36 to -0.64; P=0.03), and mean PPG levels reduced by -52.86 mg/dl (95% CI, -77.13 to -28.58; P<0.05) when compared with the group receiving standard care. Meta-regression and subgroup analyses indicated that study location, sample size, and treatment-monitoring techniques were the sources of heterogeneity. CONCLUSIONS: Patients monitored by telecare showed significant improvement in glycemic control in type 2 diabetes when compared with those monitored by routine follow-up. Significant reduction in HbA1c levels was associated with Asian populations, small sample size, and telecare, and with those patients with baseline HbA1c greater than 8.0%.

Ilozumba, O., Abejirinde, I. O., Dieleman, M., et al. (2018). "Targeting strategies of mHealth interventions for maternal health in low and middle-income countries: a systematic review protocol." *BMJ Open* **8**(2): e019345.

INTRODUCTION: Recently, there has been a steady increase in mobile health (mHealth) interventions aimed at improving maternal health of women in low-income and middle-income countries. While there is evidence indicating that these interventions contribute to improvements in maternal health outcomes, other studies indicate inconclusive results. This uncertainty has raised additional questions, one of which pertains to the role of targeting strategies in implementing mHealth interventions and the focus on pregnant women and health workers as target groups. This review aims to assess who is targeted in different mHealth interventions and the importance of targeting strategies in maternal mHealth interventions. METHODS AND ANALYSIS: We will search for peer-reviewed, English-language literature published between 1999 and July 2017 in PubMed, Web of Knowledge (Science Direct, EMBASE) and Cochrane Central Registers of Controlled Trials. The study scope is defined by the Population, Intervention, Comparison and Outcomes framework: P, community members with maternal or reproductive needs; I, electronic health or mHealth programmes geared at improving maternal or reproductive health; C, other non-electronic health or mHealth-based interventions; O, maternal health measures including family

planning, antenatal care attendance, health facility delivery and postnatal care attendance. ETHICS AND DISSEMINATION: This study is a review of already published or publicly available data and needs no ethical approval. Review results will be published in a peer-reviewed journal and presented at international conferences. PROSPERO REGISTRATION NUMBER: CRD42017072280.

Inglis, S. C., Clark, R. A., McAlister, F. A., et al. (2011). "Which components of heart failure programmes are effective? A systematic review and meta-analysis of the outcomes of structured telephone support or telemonitoring as the primary component of chronic heart failure management in 8323 patients: Abridged Cochrane Review." *Eur J Heart Fail* **13**(9): 1028-1040.

AIMS: Telemonitoring (TM) and structured telephone support (STS) have the potential to deliver specialized management to more patients with chronic heart failure (CHF), but their efficacy is still to be proven. The aim of this meta-analysis was to review randomized controlled trials (RCTs) of TM or STS for all-cause mortality and all-cause and CHF-related hospitalizations in patients with CHF, as a non-invasive remote model of a specialized disease-management intervention. METHODS AND RESULTS: We searched all relevant electronic databases and search engines, hand-searched bibliographies of relevant studies, systematic reviews, and meeting abstracts. Two reviewers independently extracted all data. Randomized controlled trials comparing TM or STS to usual care in patients with CHF were included. Studies that included intensified management with additional home or clinic-visits were excluded. Primary outcomes (mortality and hospitalizations) were analysed; secondary outcomes (cost, length of stay, and quality of life) were tabulated. Thirty RCTs of STS and TM were identified (25 peer-reviewed publications (n= 8323) and five abstracts (n= 1482)). Of the 25 peer-reviewed studies, 11 evaluated TM (2710 participants), 16 evaluated STS (5613 participants) with two testing both STS and TM in separate intervention arms compared with usual care. Telemonitoring reduced all-cause mortality {risk ratio (RR) 0.66 [95% confidence interval (CI) 0.54-0.81], P< 0.0001 }and STS showed a similar, but non-significant trend [RR 0.88 (95% CI 0.76-1.01), P= 0.08]. Both TM [RR 0.79 (95% CI 0.67-0.94), P= 0.008], and STS [RR 0.77 (95% CI 0.68-0.87), P< 0.0001] reduced CHF-related hospitalizations. Both interventions improved quality of life, reduced costs, and were acceptable to patients. Improvements in prescribing, patient-knowledge and self-care, and functional class were observed. CONCLUSION: Telemonitoring and STS both appear effective interventions to improve outcomes in patients with CHF. Systematic Review Number: Cochrane Database of Systematic Reviews. 2008:Issue 3. Art. No.: CD007228. DOI: 10.1002/14651858.CD007228.

Inglis, S. C., Conway, A., Cleland, J. G., et al. (2015). "Is age a factor in the success or failure of remote monitoring in heart failure? Telemonitoring and structured telephone support in elderly heart failure patients." *Eur J Cardiovasc Nurs* **14**(3): 248-255.

BACKGROUND: There are few data regarding the effectiveness of remote monitoring for older people with heart failure. We conducted a post-hoc sub-analysis of a previously published large Cochrane systematic review and meta-analysis of relevant randomized controlled trials to determine whether structured telephone support and telemonitoring were effective in this population. METHODS: A post hoc sub-analysis of a systematic review and meta-analysis that applied the Cochrane methodology was conducted. Meta-analyses of all-cause mortality, all-cause hospitalizations and heart failure-related hospitalizations were performed for studies where the mean or median age of participants was 70 or more years. RESULTS: The mean or median age of participants was 70 or more years in eight of the 16 (n=2659/5613; 47%) structured telephone support studies and four of the 11 (n=894/2710; 33%) telemonitoring studies. Structured telephone support (RR 0.80; 95% CI=0.63-1.00) and telemonitoring (RR 0.56; 95% CI=0.41-0.76) interventions reduced mortality. Structured

telephone support interventions reduced heart failure-related hospitalizations (RR 0.81; 95% CI=0.67-0.99). CONCLUSION: Despite a systematic bias towards recruitment of individuals younger than the epidemiological average into the randomized controlled trials, older people with heart failure did benefit from structured telephone support and telemonitoring. These post-hoc sub-analysis results were similar to overall effects observed in the main meta-analysis. While further research is required to confirm these observational findings, the evidence at hand indicates that discrimination by age alone may not be appropriate when inviting participation in a remote monitoring service for heart failure.

Iribarren, S. J., Brown, W., 3rd, Giguere, R., et al. (2017). "Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions." *Int J Med Inform* **101**: 28-40.

OBJECTIVES: Mobile technology supporting text messaging interventions (TMIs) continues to evolve, presenting challenges for researchers and healthcare professionals who need to choose software solutions to best meet their program needs. The objective of this review was to systematically identify and compare text messaging platforms and to summarize their advantages and disadvantages as described in peer-reviewed literature. METHODS: A scoping review was conducted using four steps: 1) identify currently available platforms through online searches and in mHealth repositories; 2) expand evaluation criteria of an mHealth mobile messaging toolkit and integrate prior user experiences as researchers; 3) evaluate each platform's functions and features based on the expanded criteria and a vendor survey; and 4) assess the documentation of platform use in the peer-review literature. Platforms meeting inclusion criteria were assessed independently by three reviewers and discussed until consensus was reached. The PRISMA guidelines were followed to report findings. RESULTS: Of the 1041 potentially relevant search results, 27 platforms met inclusion criteria. Most were excluded because they were not platforms (e.g., guides, toolkits, reports, or SMS gateways). Of the 27 platforms, only 12 were identified in existing mHealth repositories, 10 from Google searches, while five were found in both. The expanded evaluation criteria included 22 items. Results indicate no uniform presentation of platform features and functions, often making these difficult to discern. Fourteen of the platforms were reported as open source, 10 focused on health care and 16 were tailored to meet needs of low resource settings (not mutually exclusive). Fifteen platforms had do-it-yourself setup (programming not required) while the remainder required coding/programming skills or setups could be built to specification by the vendor. Frequently described features included data security and access to the platform via cloud-based systems. Pay structures and reported targeted end-users varied. Peer-reviewed publications listed only 6 of the 27 platforms across 21 publications. The majority of these articles reported the name of the platform used but did not describe advantages or disadvantages. CONCLUSIONS: Searching for and comparing mHealth platforms for TMIs remains a challenge. The results of this review can serve as a resource for researchers and healthcare professionals wanting to integrate TMIs into health interventions. Steps to identify, compare and assess advantages and disadvantages are outlined for consideration. Expanded evaluation criteria can be used by future researchers. Continued and more comprehensive platform tools should be integrated into mHealth repositories. Detailed descriptions of platform advantages and disadvantages are needed when mHealth researchers publish findings to expand the body of research on TMI tools for healthcare. Standardized descriptions and features are recommended for vendor sites.

Jackson, B. D., Gray, K., Knowles, S. R., et al. (2016). "EHealth Technologies in Inflammatory Bowel Disease: A Systematic Review." *J Crohns Colitis* **10**(9): 1103-1121.

BACKGROUND AND AIMS: Electronic-health technologies (eHealth) such as Web-based interventions, virtual clinics, smart-phone applications, and telemedicine are being used to

manage patients with inflammatory bowel disease (IBD). We aimed to: (1) Evaluate the impact of eHealth technologies on conventional clinical indices and patient-reported outcome measures (PROs) in IBD; (2) assess the effectiveness, cost-effectiveness and feasibility of using eHealth technologies to facilitate the self-management of individuals with IBD, and; (3) provide recommendations for their design and optimal use for patient care. METHODS: Relevant publications were identified via a literature search, and 17 publications were selected based on predefined quality parameters. RESULTS: Six randomized controlled trials and nine observational studies utilizing eHealth technologies in IBD were identified. Compared with standard outpatient-led care, eHealth technologies have led to improvements in: Relapse duration [(n = 1) 18 days vs 77 days, $p < 0.001$]; disease activity (n = 2); short-term medication adherence (n = 3); quality of life (n = 4); IBD knowledge (n = 2); healthcare costs (n = 4); the number of acute visits to the outpatient clinic due to IBD symptoms (n = 1), and; facilitating the remote management of up to 20% of an IBD cohort (n = 2). Methodological shortcomings of eHealth studies include heterogeneity of outcome measures, lack of clinician/patient input, lack of validation against conventional clinical indices and PROs, and limited cost-benefit analyses. CONCLUSIONS: EHealth technologies have the potential for promoting self-management and reducing the impact of the growing burden of IBD on health care resource utilization. A theoretical framework should be applied to the development, implementation, and evaluation of eHealth interventions.

Jayakody, A., Bryant, J., Carey, M., et al. (2016). "Effectiveness of interventions utilising telephone follow up in reducing hospital readmission within 30 days for individuals with chronic disease: a systematic review." *BMC Health Serv Res* **16**(1): 403.

BACKGROUND: Rates of readmission to hospital within 30 days are highest amongst those with chronic diseases. Effective interventions to reduce unplanned readmissions are needed. Providing support to patients with chronic disease via telephone may help prevent unnecessary readmission. This systematic review aimed to determine the methodological quality and effectiveness of interventions utilising telephone follow up (TFU) alone or in combination with other components in reducing readmission within 30 days amongst patients with cardiovascular disease, chronic respiratory disease and diabetes. METHODS: A systematic search of MEDLINE, the Cochrane Library and EMBASE were conducted for articles published from database inception to 19(th) May 2015. Interventions which included TFU alone, or in combination with other components, amongst patients with chronic disease, reported 30 day readmission outcomes and met Effective Practice and Organisation of Care design criteria were included. The titles and abstracts of all identified articles were initially assessed for relevance and rejected on initial screening by one author. Full text articles were assessed against inclusion criteria by two authors with discrepancies resolved through discussion. RESULTS: Ten studies were identified, of which five were effective in reducing readmissions within 30 days. Overall, the methodological quality of included studies was poor. All identified studies combined TFU with other intervention components. Interventions that were effective included three studies which provided TFU in addition to pre-discharge support; and two studies which provided TFU with both pre- and post-discharge support which included education, discharge planning, physical therapy and dietary consults, medication assessment, home visits and a resident curriculum. There was no evidence that TFU and telemedicine or TFU and post-discharge interventions was effective, however, only one to two studies examined each of these types of interventions. CONCLUSIONS: Evidence is inconclusive for the effectiveness of interventions utilising TFU alone or in combination with other components in reducing readmissions within 30 days in patients with chronic disease. High methodological quality studies examining the effectiveness of TFU in a standardised way are needed. There is also potential importance in focusing interventions on enhancing provider skills in patient education, transitional care and conducting TFU.

Jenkins-Guarnieri, M. A., Pruitt, L. D., Luxton, D. D., et al. (2015). "Patient Perceptions of Telemental Health: Systematic Review of Direct Comparisons to In-Person Psychotherapeutic Treatments." *Telemed J E Health* **21**(8): 652-660.

BACKGROUND: Although there is growing empirical support for the clinical efficacy of telemental health (TMH) treatments, questions remain about how patient perceptions of the TMH treatment process may compare with those of traditional in-person psychotherapy treatments. **MATERIALS AND METHODS:** Through a systematic review, we specifically examine measures of patient treatment satisfaction and therapeutic alliance in studies that included direct comparisons of video conferencing or telephone-based psychotherapeutic TMH treatments with in-person treatment delivery. We performed a comprehensive search of the PsychINFO and MEDLINE databases for articles published in the last 10 years (2004-2014) on TMH treatments that included in-person comparison groups, yielding 552 initial results with 14 studies meeting our full inclusion criteria. **RESULTS:** The findings generally show comparable treatment satisfaction as well as similar ratings of therapeutic alliance. Some results suggested the potential for decreased patient comfort with aspects of group treatment delivered via TMH. **CONCLUSIONS:** We discuss implications for providing psychotherapeutic treatments via TMH and review practice recommendations for assuring and enhancing satisfaction with TMH services.

Johnston, B. (2011). "UK telehealth initiatives in palliative care: a review." *Int J Palliat Nurs* **17**(6): 301-308.

This review paper explores the use of telehealth in relation to palliative care in the UK. Information technology (IT) developments are being harnessed throughout society, and there is growing interest in the ways in which they can be used to meet and support patients' health needs in the community. The aim of the literature review was to scope the information available from published and unpublished research, with particular reference to older people. The evidence suggests that, despite the challenges, there are numerous examples of good practice in relation to telehealth, palliative and end-of-life care, and older people. Developments in technology that have increased the capacity to improve care, through reaching greater numbers of people of all age groups, mean that telehealth has much to offer people living with and dying from advanced illness. However, some of the evaluative evidence is limited and further rigour is needed when evaluating future telehealth innovations.

Kamei, T., Yamamoto, Y., Kajii, F., et al. (2013). "Systematic review and meta-analysis of studies involving telehome monitoring-based telenursing for patients with chronic obstructive pulmonary disease." *Jpn J Nurs Sci* **10**(2): 180-192.

AIM: This systematic review evaluated the effects of telehome monitoring-based telenursing (THMTN) on health outcomes and use of healthcare services and compared them with the effects of conventional treatment in patients with severe and very severe chronic obstructive pulmonary disease (COPD). **METHODS:** An extensive published work search of several databases was performed in May and October 2011. Randomized controlled trials and non-randomized controlled clinical trials were evaluated. Parameters included hospitalization rate, number of visits to the emergency department, exacerbations, mean number of hospitalizations, mean duration of bed days of care, mortality, and health-related quality of life by the duration of THMTN and COPD severity. A random effects model was applied. Risk ratio and mean difference were calculated. Heterogeneity was assessed using the I(2) statistic. **RESULTS:** Nine original articles involving 550 participants were identified in the

meta-analysis. THMTN decreased hospitalization rates, emergency department visits, exacerbations, mean number of hospitalizations, and mean duration of bed days of care in severe and very severe COPD patients. Hospitalization rates and emergency department visits were comparable between patients undergoing THMTN of different durations. In addition, THMTN had no effect on mortality. CONCLUSION: THMTN significantly decreases the use of healthcare services; however, it does not affect mortality in severe and very severe COPD patients.

Kaminsky, E., Roing, M., Bjorkman, A., et al. (2017). "Telephone nursing in Sweden: A narrative literature review." *Nurs Health Sci* **19**(3): 278-286.

Telephone nursing services are expanding globally. Swedish Healthcare Direct is the largest healthcare provider in Sweden. This paper provides a comprehensive understanding of telephone nursing, as reflected by research on Swedish national telephone nursing, and discusses the findings in relation to international literature. A descriptive, mixed-studies literature review was conducted. Twenty-four articles from January 2003 to April 2015 were identified from PubMed, Scopus, and CINAHL, and included. The issues explored in this study are how telephone nursing is perceived by callers, telephone nurses, and managers, and what characterizes such calls. Callers value reassurance, support, respect and satisfaction and involvement in decisions can increase their adherence. The telephone nurses' perspective focused on problems and ethical dilemmas, communication, the decision support tool, and working tasks. The managers' perspective focused on nursing work goals and malpractice claims. Concerning call characteristics, authentic calls, incident reports, and threats to patient safety were considered. Telephone nursing seems safe, but gender can play a role in calls. Future research on caller access, equity, and efficiency, healthcare cost-effectiveness, distribution, and patient safety is needed.

Kassavou, A. et Sutton, S. (2018). "Automated telecommunication interventions to promote adherence to cardio-metabolic medications: meta-analysis of effectiveness and meta-regression of behaviour change techniques." *Health Psychol Rev* **12**(1): 25-42.

Automated telecommunication interventions, including short message service and interactive voice response, are increasingly being used to promote adherence to medications prescribed for cardio-metabolic conditions. This systematic review aimed to comprehensively assess the effectiveness of such interventions to support medication adherence, and to identify the behaviour change techniques (BCTs) and other intervention characteristics that are positively associated with greater intervention effectiveness. Meta-analysis of 17 randomised controlled trials showed a small but statistically significant effect on medication adherence, OR = 1.89, 95% CI [1.51, 2.36], I(2) = 89%, N = 25,101. Multivariable meta-regression analysis including eight BCTs explained 88% of the observed variance in effect size (ES). The BCTs 'tailored' and 'information about health consequences' were positively and significantly associated with ES. Future studies could explore whether the inclusion of these and/or additional techniques (e.g., 'implementation intentions') would increase the effect of automated telecommunication interventions, using rigorous designs and objective outcome measures.

Kebede, M. M., Zeeb, H., Peters, M., et al. (2018). "Effectiveness of Digital Interventions for Improving Glycemic Control in Persons with Poorly Controlled Type 2 Diabetes: A Systematic Review, Meta-analysis, and Meta-regression Analysis." *Diabetes Technol Ther* **20**(11): 767-782.

BACKGROUND: Digital interventions may assist patients with type 2 diabetes in improving glycemic control. We aimed to synthesize effect sizes of digital interventions on glycated

hemoglobin (HbA1c) levels and to identify effective features of digital interventions targeting patients with poorly controlled type 2 diabetes. MATERIALS AND METHODS: MEDLINE, ISI Web of Science, and PsycINFO were searched for randomized controlled trials (RCTs) comparing the effects of digital interventions with usual care. Two reviewers independently assessed studies for eligibility and determined study quality, using the Cochrane Risk of Bias Assessment Tool. The Behavioral Change Technique Taxonomy V1 (BCTTv1) was used to identify BCTs used in interventions. Mean HbA1c differences were pooled using analysis of covariance to adjust for baseline differences and pre-post correlations. To examine effective intervention features and to evaluate differences in effect sizes across groups, meta-regression and subgroup analyses were performed. RESULTS: Twenty-three arms of 21 RCTs were included in the meta-analysis (n = 3787 patients, 52.6% in intervention arms). The mean HbA1c baseline differences ranged from -0.2% to 0.64%. The pooled mean HbA1c change was statistically significant (-0.39 [95% CI: [-0.51 to -0.26]]) with substantial heterogeneity [I(2) statistic, 80.8%]) and a significant HbA1c reduction was noted for web-based interventions. A baseline HbA1c level above 7.5%, beta = -0.44 (95% CI: [-0.81 to -0.06]), the BCTs "problem solving," beta = -1.30 (95% CI: [-2.05 to -0.54]), and "self-monitoring outcomes of behavior," beta = -1.21 (95% CI: [-1.95 to -0.46]) were significantly associated with reduced HbA1c levels. CONCLUSIONS: Digital interventions appear effective for reducing HbA1c levels in patients with poorly controlled type 2 diabetes.

Kitsiou, S., Pare, G. et Jaana, M. (2015). "Effects of home telemonitoring interventions on patients with chronic heart failure: an overview of systematic reviews." *J Med Internet Res* **17**(3): e63.

BACKGROUND: Growing interest on the effects of home telemonitoring on patients with chronic heart failure (HF) has led to a rise in the number of systematic reviews addressing the same or very similar research questions with a concomitant increase in discordant findings. Differences in the scope, methods of analysis, and methodological quality of systematic reviews can cause great confusion and make it difficult for policy makers and clinicians to access and interpret the available evidence and for researchers to know where knowledge gaps in the extant literature exist. OBJECTIVE: This overview aims to collect, appraise, and synthesize existing evidence from multiple systematic reviews on the effectiveness of home telemonitoring interventions for patients with chronic heart failure (HF) to inform policy makers, practitioners, and researchers. METHODS: A comprehensive literature search was performed on MEDLINE, EMBASE, CINAHL, and the Cochrane Library to identify all relevant, peer-reviewed systematic reviews published between January 1996 and December 2013. Reviews were searched and screened using explicit keywords and inclusion criteria. Standardized forms were used to extract data and the methodological quality of included reviews was appraised using the AMSTAR (assessing methodological quality of systematic reviews) instrument. Summary of findings tables were constructed for all primary outcomes of interest, and quality of evidence was graded by outcome using the GRADE (Grades of Recommendation, Assessment, Development, and Evaluation) system. Post-hoc analysis and subgroup meta-analyses were conducted to gain further insights into the various types of home telemonitoring technologies included in the systematic reviews and the impact of these technologies on clinical outcomes. RESULTS: A total of 15 reviews published between 2003 and 2013 were selected for meta-level synthesis. Evidence from high-quality reviews with meta-analysis indicated that taken collectively, home telemonitoring interventions reduce the relative risk of all-cause mortality (0.60 to 0.85) and heart failure-related hospitalizations (0.64 to 0.86) compared with usual care. Absolute risk reductions ranged from 1.4%-6.5% and 3.7%-8.2%, respectively. Improvements in HF-related hospitalizations appeared to be more pronounced in patients with stable HF: hazard ratio (HR) 0.70 (95% credible interval [CrI] 0.34-1.5)). Risk reductions in mortality and all-cause hospitalizations appeared to be greater in patients who had been recently discharged (</=28 days) from an

acute care setting after a recent HF exacerbation: HR 0.62 (95% CrI 0.42-0.89) and HR 0.67 (95% CrI 0.42-0.97), respectively. However, quality of evidence for these outcomes ranged from moderate to low suggesting that further research is very likely to have an important impact on our confidence in the observed estimates of effect and may change these estimates. The post-hoc analysis identified five main types of non-invasive telemonitoring technologies included in the systematic reviews: (1) video-consultation, with or without transmission of vital signs, (2) mobile telemonitoring, (3) automated device-based telemonitoring, (4) interactive voice response, and (5) Web-based telemonitoring. Of these, only automated device-based telemonitoring and mobile telemonitoring were effective in reducing the risk of all-cause mortality and HF-related hospitalizations. More research data are required for interactive voice response systems, video-consultation, and Web-based telemonitoring to provide robust conclusions about their effectiveness. CONCLUSIONS: Future research should focus on understanding the process by which home telemonitoring works in terms of improving outcomes, identify optimal strategies and the duration of follow-up for which it confers benefits, and further investigate whether there is differential effectiveness between chronic HF patient groups and types of home telemonitoring technologies.

Klersy, C., Boriani, G., De Silvestri, A., et al. (2016). "Effect of telemonitoring of cardiac implantable electronic devices on healthcare utilization: a meta-analysis of randomized controlled trials in patients with heart failure." *Eur J Heart Fail* **18**(2): 195-204.

AIMS: Implantable device telemonitoring (DTM) is a diagnostic adjunct to traditional face-to-face hospital visits. Remote device follow-up and earlier diagnoses facilitated by DTM should reduce healthcare utilization. We explored whether DTM reduces healthcare utilization over standard of care (SoC), without compromising patient outcomes. METHODS AND RESULTS: This systematic review and meta-analysis of 11 randomized controlled trials on DTM in patients with heart failure consisted of 5702 patients, with a median of 117 [interquartile range (IQR) 76-331] patients per study [age 65 years (IQR 63-67)] and follow-up range of 12-36 months. DTM was associated with a reduction in total number of visits [planned, unplanned, and emergency room (ER)] [relative risk (RR) 0.56; 95% confidence interval (CI) 0.43-0.73, $P < 0.001$]. Rates of cardiac hospitalizations (RR 0.96; 95% CI 0.82-1.12, $P = 0.60$) and the composite endpoints of ER, unplanned hospital visits, or hospitalizations (RR 0.99; 95% CI 0.68-1.43, $P = 0.96$) was similar between the DTM and the SoC groups. An increase in the total number of ER or unscheduled visits (RR 1.37; 95% CI 1.11-1.70, $P = 0.004$) was observed. This effect was consistent and statistically significant for all studies. Total and cardiac mortality were similar between the groups (DTM RR 0.90; 95% CI 0.69-1.16, $P = 0.41$; and DTM RR 0.93; 95% CI 0.51-1.69, $P = 0.80$). Monetary costs favoured DTM (10-55% reduction in five studies). CONCLUSIONS: Compared with SoC, DTM is associated with a marked reduction in planned hospital visits. In addition, DTM was associated with lower monetary costs, despite a modest increase in unplanned hospital and ER visits. DTM did not compromise survival.

Kongstad, M. B., Valentiner, L. S., Ried-Larsen, M., et al. (2019). "Effectiveness of remote feedback on physical activity in persons with type 2 diabetes: A systematic review and meta-analysis of randomized controlled trials." *J Telemed Telecare* **25**(1): 26-34.

OBJECTIVES: The objective of this systematic review and meta-analysis was to examine the effectiveness of remote feedback intervention compared with standardized treatment on physical activity levels in persons with type 2 diabetes. Further, to investigate the influence of the length of intervention, number of contacts, study size, delivery of feedback, and preliminary face-to-face sessions. METHODS: A systematic literature search was conducted in

May 2017, with a priori defined eligibility criteria: randomized controlled trials investigating remote feedback interventions in adult persons with type 2 diabetes, using physical activity as outcome. The effect size was calculated as standardized mean difference (SMD) and was pooled in a meta-analysis using a random-effects model. Meta-regression analyses were performed to examine if the observed effect size could be attributed to study- or intervention characteristics using these as covariates. RESULTS: The literature search identified 4455 articles of which 27 met the eligibility criteria. The meta-analysis including a total of 4215 participants found an overall effect size in favour of remote feedback interventions compared to standardized treatment, SMD = 0.33 (95% CI: 0.17 to 0.49), I(2) = 81.7%). Analyses on study characteristics found that the effect on physical activity was only influenced by study size, with a larger effect in small studies. CONCLUSION: Adding remote feedback to standardized treatments aimed at increasing physical activity in persons with type 2 diabetes showed a small to moderate additional increase in physical activity levels. Systematic review registration: PROSPERO CRD42016033479.

Kotb, A., Cameron, C., Hsieh, S., et al. (2015). "Comparative effectiveness of different forms of telemedicine for individuals with heart failure (HF): a systematic review and network meta-analysis." PLoS One **10**(2): e0118681.

BACKGROUND: Previous studies on telemedicine have either focused on its role in the management of chronic diseases in general or examined its effectiveness in comparison to standard post-discharge care. Little has been done to determine the comparative impact of different telemedicine options for a specific population such as individuals with heart failure (HF). METHODS AND FINDINGS: Systematic reviews (SR) of randomized controlled trials (RCTs) that examined telephone support, telemonitoring, video monitoring or electrocardiographic monitoring for HF patients were identified using a comprehensive search of the following databases: MEDLINE, EMBASE, CINAHL and The Cochrane Library. Studies were included if they reported the primary outcome of mortality or any of the following secondary outcomes: all-cause hospitalization and heart failure hospitalization. Thirty RCTs (N = 10,193 patients) were included. Compared to usual care, structured telephone support was found to reduce the odds of mortality (Odds Ratio 0.80; 95% Credible Intervals [0.66 to 0.96]) and hospitalizations due to heart failure (0.69; [0.56 to 0.85]). Telemonitoring was also found to reduce the odds of mortality (0.53; [0.36 to 0.80]) and reduce hospitalizations related to heart failure (0.64; [0.39 to 0.95]) compared to usual post-discharge care. Interventions that involved ECG monitoring also reduced the odds of hospitalization due to heart failure (0.71; [0.52 to 0.98]). LIMITATIONS: Much of the evidence currently available has focused on the comparing either telephone support or telemonitoring with usual care. This has therefore limited our current understanding of how some of the less common forms of telemedicine compare to one another. CONCLUSIONS: Compared to usual care, structured telephone support and telemonitoring significantly reduced the odds of deaths and hospitalization due to heart failure. Despite being the most widely studied forms of telemedicine, little has been done to directly compare these two interventions against one another. Further research into their comparative cost-effectiveness is also warranted.

Lee, J., Bedra, M. et Finkelstein, J. (2014). "A critical review of consumer health devices for stress self-management." Stud Health Technol Inform **202**: 221-224.

A number of consumer health devices have been advertised as effective means to manage individual stress. However, objective evidence of their efficacy is not readily available. We present a critical analysis of evidence related to efficacy of stress management devices based on comprehensive literature review and information provided by the vendors. The analysis was conducted along four dimensions: metrics, theoretical frameworks, evaluation, and FDA

clearance. The review resulted in identification of critical issues including limited information on operational characteristics, controversial theoretical underpinnings, and lack of systematic evaluation. Efficacy of these consumer devices has yet to be established.

Lee, J. A., Choi, M., Lee, S. A., et al. (2018). "Effective behavioral intervention strategies using mobile health applications for chronic disease management: a systematic review." BMC Med Inform Decis Mak **18**(1): 12.

BACKGROUND: Mobile health (mHealth) has continuously been used as a method in behavioral research to improve self-management in patients with chronic diseases. However, the evidence of its effectiveness in chronic disease management in the adult population is still lacking. We conducted a systematic review to examine the effectiveness of mHealth interventions on process measures as well as health outcomes in randomized controlled trials (RCTs) to improve chronic disease management. **METHODS:** Relevant randomized controlled studies that were published between January 2005 and March 2016 were searched in six databases: PubMed, CINAHL, EMBASE, the Cochrane Library, PsycINFO, and Web of Science. The inclusion criteria were RCTs that conducted an intervention using mobile devices such as smartphones or tablets for adult patients with chronic diseases to examine disease management or health promotion. **RESULTS:** Of the 12 RCTs reviewed, 10 of the mHealth interventions demonstrated statistically significant improvement in some health outcomes. The most common features of mHealth systems used in the reviewed RCTs were real-time or regular basis symptom assessments, pre-programed reminders, or feedbacks tailored specifically to the data provided by participants via mHealth devices. Most studies developed their own mHealth systems including mobile apps. Training of mHealth systems was provided to participants in person or through paper-based instructions. None of the studies reported the relationship between health outcomes and patient engagement levels on the mHealth system. **CONCLUSIONS:** Findings from mHealth intervention studies for chronic disease management have shown promising aspects, particularly in improving self-management and some health outcomes.

Lee, P. A., Greenfield, G. et Pappas, Y. (2018). "The impact of telehealth remote patient monitoring on glycemic control in type 2 diabetes: a systematic review and meta-analysis of systematic reviews of randomised controlled trials." BMC Health Serv Res **18**(1): 495.

BACKGROUND: There is a growing body of evidence to support the use of telehealth in monitoring HbA1c levels in people living with type 2 diabetes. However, the overall magnitude of effect is yet unclear due to variable results reported in existing systematic reviews. The objective of this study is to conduct a systematic review and meta-analysis of systematic reviews of randomised controlled trials to create an evidence-base for the effectiveness of telehealth interventions on glycemic control in adults with type 2 diabetes. **METHODS:** Electronic databases including The Cochrane Library, MEDLINE, EMBASE, HMIC, and PsycINFO were searched to identify relevant systematic reviews published between 1990 and April 2016, supplemented by references search from the relevant reviews. Two independent reviewers selected and reviewed the eligible studies. Of the 3279 references retrieved, 4 systematic reviews reporting in total 29 unique studies relevant to our review were included. Both conventional pairwise meta-analyses and network meta-analyses were performed. **RESULTS:** Evidence from pooling four systematic reviews found that telehealth interventions produced a small but significant improvement in HbA1c levels compared with usual care (MD: -0.55, 95% CI: -0.73 to - 0.36). The greatest effect was seen in telephone-delivered interventions, followed by Internet blood glucose monitoring system interventions and lastly interventions involving automatic transmission of SMBG using a mobile phone or a telehealth unit. **CONCLUSION:** Current evidence suggests that telehealth is effective in

controlling HbA1c levels in people living with type 2 diabetes. However there is need for better quality primary studies as well as systematic reviews of RCTs in order to confidently conclude on the impact of telehealth on glycemic control in type 2 diabetes.

Lin, M. H., Yuan, W. L., Huang, T. C., et al. (2017). "Clinical effectiveness of telemedicine for chronic heart failure: a systematic review and meta-analysis." *J Investig Med* **65**(5): 899-911.

Telemedicine interventions may be associated with reductions in hospital admission rate and mortality in patients with heart failure (HF). The present study is an updated analysis (as of June 30, 2016) of randomized controlled trials, where patients with HF underwent telemedicine care or the usual standard care. Data were extracted from 39 eligible studies for all-cause and HF-related hospital admission rate, length of stay, and mortality. The overall all-cause mortality (pooled OR=0.80, 95% CI 0.71 to 0.91, $p<0.001$), HF-related admission rate (pooled OR=0.63, 95% CI 0.53 to 0.76, $p<0.001$), and HF-related length of stay (pooled standardized difference in means=-0.37, 95% CI -0.72 to -0.02, $p=0.041$) were significantly lower in the telemedicine group (teletransmission and telephone-supported care), as compared with the control group. In subgroup analysis, all-cause mortality (pooled OR=0.69, 95% CI 0.56 to 0.86, $p=0.001$), HF-related admission rate (OR=0.61, 95% CI 0.42 to 0.88, $p=0.008$), HF-related length of stay (pooled standardized difference in means=-0.96, 95% CI -1.88 to -0.05, $p=0.039$) and HF-related mortality (OR=0.68, 95% CI 0.54 to 0.85, $p=0.001$) were significantly lower in the teletransmission group, as opposed to the standard care group, whereas only HF-related admission rate (OR=0.64, 95% CI 0.52 to 0.79, $p<0.001$) was lower in the telephone-supported care group. Overall, telemedicine was shown to be beneficial, with home-based teletransmission effectively reducing all-cause mortality and HF-related hospital admission, length of stay and mortality in patients with HF.

Liptrott, S., Bee, P. et Lovell, K. (2018). "Acceptability of telephone support as perceived by patients with cancer: A systematic review." *Eur J Cancer Care (Engl)* **27**(1).

Telephone-based interventions can increase accessibility to healthcare and are increasingly used as a convenient method of providing support. We conducted a systematic review of published literature reporting adult patients' perceptions of the acceptability of, and satisfaction with, telephone-based interventions during or post-treatment for cancer. Systematic searches identified 4,855 articles. Forty-eight articles describing 50 studies were included in the review. Three intervention categories were identified post hoc: (1) telephone follow-up in lieu of routine hospital follow-up, (2) telephone interventions for treatment side-effect monitoring and toxicity management supplementary to usual care, and (3) supplementary psycho-educational telephone interventions. Across studies, some consistent findings emerged. Positive perceptions emphasised the convenience of telephone interventions and increased accessibility to care. Conflicting perceptions of the quality of the support received, the impact of telecare on the patient-healthcare professional relationship and the need for such interventions emerged. In conclusion, the evidence base relating to patients' perceptions of telephone-based interventions is increasing. Interpretation of findings is currently limited by methodological limitations in the primary research. The instruments chosen to assess patient satisfaction quantitatively do not always reflect the patient-centred priorities that emerge from qualitative data. Subsequent research would benefit from well-designed qualitative studies and patient-centred outcome measures to ensure that the individuality of participants' positive and negative experiences is captured.

Liu, L., Stroulia, E., Nikolaidis, I., et al. (2016). "Smart homes and home health monitoring technologies for older adults: A systematic review." *Int J Med Inform* **91**: 44-59.

BACKGROUND: Around the world, populations are aging and there is a growing concern about ways that older adults can maintain their health and well-being while living in their homes. **OBJECTIVES:** The aim of this paper was to conduct a systematic literature review to determine: (1) the levels of technology readiness among older adults and, (2) evidence for smart homes and home-based health-monitoring technologies that support aging in place for older adults who have complex needs. **RESULTS:** We identified and analyzed 48 of 1863 relevant papers. Our analyses found that: (1) technology-readiness level for smart homes and home health monitoring technologies is low; (2) the highest level of evidence is 1b (i.e., one randomized controlled trial with a PEDro score ≥ 6); smart homes and home health monitoring technologies are used to monitor activities of daily living, cognitive decline and mental health, and heart conditions in older adults with complex needs; (3) there is no evidence that smart homes and home health monitoring technologies help address disability prediction and health-related quality of life, or fall prevention; and (4) there is conflicting evidence that smart homes and home health monitoring technologies help address chronic obstructive pulmonary disease. **CONCLUSIONS:** The level of technology readiness for smart homes and home health monitoring technologies is still low. The highest level of evidence found was in a study that supported home health technologies for use in monitoring activities of daily living, cognitive decline, mental health, and heart conditions in older adults with complex needs.

Liu, S., Feng, W., Chhatbar, P. Y., et al. (2017). "Mobile health as a viable strategy to enhance stroke risk factor control: A systematic review and meta-analysis." *J Neurol Sci* **378**: 140-145.

BACKGROUND: With the rapid growth worldwide in cell-phone use, Internet connectivity, and digital health technology, mobile health (mHealth) technology may offer a promising approach to bridge evidence-treatment gaps in stroke prevention. We aimed to evaluate the effectiveness of mHealth for stroke risk factor control through a systematic review and meta-analysis. **METHODS:** We searched PubMed from January 1, 2000 to May 17, 2016 using the following keywords: mobile health, mHealth, short message, cellular phone, mobile phone, stroke prevention and control, diabetes mellitus, hypertension, hyperlipidemia and smoking cessation. We performed a meta-analysis of all eligible randomized control clinical trials that assessed a sustained (at least 6months) effect of mHealth. **RESULTS:** Of 78 articles identified, 13 met eligibility criteria (6 for glycemic control and 7 for smoking cessation) and were included for the final meta-analysis. There were no eligible studies for dyslipidemia or hypertension. mHealth resulted in greater Hemoglobin A1c reduction at 6months (6 studies; 663 subjects; SMD: -0.44; 95% CI: [-0.82, -0.06], $P=0.02$; Mean difference of decrease in HbA1c: -0.39%; 95% CI: [-0.74, -0.04], $P=0.03$). mHealth also lead to relatively higher smoking abstinence rates at 6months (7 studies; 9514 subjects; OR: 1.54; 95% CI: [1.24, 1.90], $P<0.0001$). **CONCLUSIONS:** Our meta-analysis supports that use of mHealth improves glycemic control and smoking abstinence rates.

Lundell, S., Holmner, A., Rehn, B., et al. (2015). "Telehealthcare in COPD: a systematic review and meta-analysis on physical outcomes and dyspnea." *Respir Med* **109**(1): 11-26.

BACKGROUND: Only a minority of patients with chronic obstructive pulmonary disease (COPD) have access to pulmonary rehabilitation (PR). Home-based solutions such as telehealthcare, have been used in efforts to make PR more available. The aim of this systematic review was to investigate the effects of telehealthcare on physical activity level, physical capacity and dyspnea in patients with COPD, and to describe the interventions used. **METHODS:** Randomized controlled trials were identified through database searches, reference lists and included authors. Articles were reviewed based on eligibility criteria by three authors. Risk of bias was assessed by two authors. Standardized mean differences

(SMD) or mean differences (MD) with 95% CI were calculated. Forest plots were used to present data visually. RESULTS: Nine studies (982 patients) were included. For physical activity level, there was a significant effect favoring telehealthcare (MD, 64.7 min; 95% CI, 54.4-74.9). No difference between groups was found for physical capacity (MD, -1.3 m; 95% CI, -8.1-5.5) and dyspnea (SMD, 0.088; 95% CI, -0.056-0.233). Telehealthcare was promoted through phone calls, websites or mobile phones, often combined with education and/or exercise training. Comparators were ordinary care, exercise training and/or education. CONCLUSIONS: The use of telehealthcare may lead to improvements in physical activity level, although the results should be interpreted with caution given the heterogeneity in studies. This is an important area of research and further studies of the effect of telehealthcare for patients with COPD would be beneficial. REGISTRATION: In PROSPERO 2012: CRD42012003294. STUDY PROTOCOL: http://www.crd.york.ac.uk/PROSPEROFILES/3294_PROTOCOL_20121016.pdf.

Luo, L., Ye, M., Tan, J., et al. (2019). "Telehealth for the management of blood pressure in patients with chronic kidney disease: A systematic review." *J Telemed Telecare* **25**(2): 80-92.

BACKGROUND: Most patients with chronic kidney disease (CKD) fail to achieve blood pressure (BP) management as recommended. Meanwhile, the effects of promising intervention and telehealth on BP control in CKD patients remain unclear. We aimed to evaluate the efficacy of telehealth for BP in CKD non-dialysis patients. METHODS: Databases including MEDLINE, EMBASE, CENTRAL, CNKI, Wanfang, VIP and CBM were systematically searched for randomised controlled trials or quasi-randomised controlled trials on telehealth for BP control of CKD3-5 non-dialysis patients. We analysed systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), serum creatinine, and estimated glomerular filtration rate (eGFR) with a fixed-effects model. RESULTS: Three studies, with total 680 subjects, were included in our systematic review and two were included for meta-analysis. Pooled estimates showed decreased SBP (pooled mean difference (MD), -5.10; 95% confidence interval (CI), -11.34, 1.14; $p > 0.05$, $p = 0.11$), increased DBP (pooled MD, 0.45; 95% CI, -4.24, 5.13; $p > 0.05$, $p = 0.85$), decreased serum creatinine (pooled MD, -0.38; 95% CI, -0.83, 0.07; $p > 0.05$, $p = 0.10$) and maintained eGFR (pooled MD, 4.72; 95% CI, -1.85, 11.29; $p > 0.05$, $p = 0.16$) in the telehealth group. There was no significant difference from the control group. MAP (MD, 0.6; 95% CI, -6.61, 7.81; $p > 0.05$, $p = 0.87$) and BP control rate ($p > 0.05$, $p = 0.8$), respectively, shown in two studies also demonstrated no statistical significance in the telehealth group. CONCLUSIONS: There was no statistically significant evidence to support the superiority of telehealth for BP management in CKD patients. This suggests further studies with improved study design and optimised intervention are needed in the future.

Marcolino, M. S., Maia, J. X., Alkmim, M. B., et al. (2013). "Telemedicine application in the care of diabetes patients: systematic review and meta-analysis." *PLoS One* **8**(11): e79246.

BACKGROUND: The impact of telemedicine application on the management of diabetes patients is unclear, as the results are not consistent among different studies. The objective of this study is to conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) assessing the impact of telemedicine interventions on change in hemoglobin A1c (HbA1c), blood pressure, LDL cholesterol (LDL-c) and body mass index (BMI) in diabetes patients. METHODS: Electronic databases MEDLINE, Cochrane Central Register of Controlled Trials and LILACS were searched to identify relevant studies published until April 2012, supplemented by references from the selected articles. Study search and selection were performed by independent reviewers. Of the 6.258 articles retrieved, 13 RCTs (4207 patients) were included. Random effects model was applied to estimate the pooled results. RESULTS:

Telemedicine was associated with a statistically significant and clinically relevant absolute decline in HbA1c level compared to control (mean difference -0.44% [-4.8 mmol/mol] and 95% confidence interval [CI] -0.61 to -0.26% [-6.7 to -2.8 mmol/mol]; $p < 0.001$). LDL-c was reduced in 6.6 mg/dL (95% CI -8.3 to -4.9; $p < 0.001$), but the clinical relevance of this effect can be questioned. No effects of telemedicine strategies were seen on systolic (-1.6 mmHg and 95% CI -7.2 to 4.1) and diastolic blood pressure (-1.1 mmHg and 95% CI -3.0 to 0.8). The 2 studies that assessed the effect on BMI demonstrated a tendency of BMI reduction in favor of telemedicine. CONCLUSIONS: Telemedicine strategies combined to the usual care were associated with improved glycemic control in diabetic patients. No clinical relevant impact was observed on LDL-c and blood pressure, and there was a tendency of BMI reduction in diabetes patients who used telemedicine, but these outcomes should be further explored in future trials.

McCarroll, R., Eyles, H. et Ni Mhurchu, C. (2017). "Effectiveness of mobile health (mHealth) interventions for promoting healthy eating in adults: A systematic review." *Prev Med* **105**: 156-168.

Unhealthy eating is a major risk factor for chronic disease. However, many current strategies to promote healthy eating are not sustainable over the longer-term. More cost-effective wide-reaching initiatives are urgently needed. Mobile health (mHealth) interventions, delivered via mobile devices, could provide a solution. This systematic review summarized the evidence on the effect of mHealth interventions for promoting healthy eating in adults. A comprehensive systematic search of five scientific databases was conducted using methods adapted from the Cochrane Handbook. Eligible studies were randomized controlled trials (RCTs), published up to 1 July 2016, which examined healthy eating interventions delivered via mobile device. Of 879 articles identified, 84 full text articles were potentially eligible and further assessed, and 23 included. Narrative review results indicated small positive effects of mHealth interventions on healthy eating (5/8 trials) and weight loss (5/13 trials). However, the current evidence base is insufficient (studies are of poor quality) to determine conclusive positive effects. More rigorous RCTs with longer-term (>6months) follow-up are warranted to determine if effects are maintained.

McKay, F. H., Cheng, C., Wright, A., et al. (2018). "Evaluating mobile phone applications for health behaviour change: A systematic review." *J Telemed Telecare* **24**(1): 22-30.

Introduction Increasing smartphones access has allowed for increasing development and use of smart phone applications (apps). Mobile health interventions have previously relied on voice or text-based short message services (SMS), however, the increasing availability and ease of use of apps has allowed for significant growth of smartphone apps that can be used for health behaviour change. This review considers the current body of knowledge relating to the evaluation of apps for health behaviour change. The aim of this review is to investigate approaches to the evaluation of health apps to identify any current best practice approaches. Method A systematic review was conducted. Data were collected and analysed in September 2016. Thirty-eight articles were identified and have been included in this review. Results Articles were published between 2011- 2016, and 36 were reviews or evaluations of apps related to one or more health conditions, the remaining two reported on an investigation of the usability of health apps. Studies investigated apps relating to the following areas: alcohol, asthma, breastfeeding, cancer, depression, diabetes, general health and fitness, headaches, heart disease, HIV, hypertension, iron deficiency/anaemia, low vision, mindfulness, obesity, pain, physical activity, smoking, weight management and women's health. Conclusion In order to harness the potential of mobile health apps for behaviour change and health, we need better ways to assess the quality and effectiveness of apps. This review is unable to suggest a single best practice approach to evaluate mobile health apps. Few measures

identified in this review included sufficient information or evaluation, leading to potentially incomplete and inaccurate information for consumers seeking the best app for their situation. This is further complicated by a lack of regulation in health promotion generally.

McLean, G., Murray, E., Band, R., et al. (2016). "Interactive digital interventions to promote self-management in adults with asthma: systematic review and meta-analysis." *BMC Pulm Med* **16**(1): 83.

BACKGROUND: To identify, summarise and synthesise the evidence for using interactive digital interventions to support patient self-management of asthma, and determine their impact. **METHODS:** Systematic review with meta-analysis. We searched MEDLINE, EMBASE, CINAHL, PsycINFO, ERIC, Cochrane Library, DoPHER, TROPHI, Social Science Citation Index and Science Citation Index. The selection criteria requirement was studies of adults (16 years and over) with asthma, interventions that were interactive digital interventions and the comparator was usual care. Outcomes were change in clinical outcomes, cost effectiveness and patient-reported measures of wellbeing or quality of life. Only Randomised Controlled Trials published in peer-reviewed journals in English were eligible. Potential studies were screened and study characteristics and outcomes were extracted from eligible papers independently by two researchers. Where data allowed, meta-analysis was performed using a random effects model. **RESULTS:** Eight papers describing 5 trials with 593 participants were included, but only three studies were eligible for inclusion for meta-analysis. Of these, two aimed to improve asthma control and the third aimed to reduce the total dose of oral prednisolone without worsening control. Analyses with data from all three studies showed no significant differences and extremely high heterogeneity for both Asthma Quality of Life (AQLQ) (Standardised Mean Difference (SMD) 0.05; 95 % Confidence Interval (CI) 0.32 to -0.22; I² 96.8) and asthma control (SMD 0.21; 95 % CI -0.05 to .42; I² = 87.4). The removal of the third study reduced heterogeneity and indicated significant improvement for both AQLQ (SMD 0.45; 95 % CI 0.13 to 0.77; I² = 0.34) and asthma control (SMD 0.54; 95 % CI 0.22 to 0.86; I² = 0.11). No evidence of harm was identified. **CONCLUSION:** Digital self-management interventions for adults with asthma show promise, with some evidence of small beneficial effects on asthma control. Overall, the evidence base remains weak due to the lack of large, robust trials.

McLean, S., Chandler, D., Nurmatov, U., et al. (2011). "Telehealthcare for asthma: a Cochrane review." *Cmaj* **183**(11): E733-742.

BACKGROUND: Telehealthcare has the potential to provide care for long-term conditions that are increasingly prevalent, such as asthma. We conducted a systematic review of studies of telehealthcare interventions used for the treatment of asthma to determine whether such approaches to care are effective. **METHODS:** We searched the Cochrane Airways Group Specialised Register of Trials, which is derived from systematic searches of bibliographic databases including CENTRAL (the Cochrane Central Register of Controlled Trials), MEDLINE, Embase, CINAHL (Cumulative Index to Nursing and Allied Health Literature) and PsycINFO, as well as other electronic resources. We also searched registers of ongoing and unpublished trials. We were interested in studies that measured the following outcomes: quality of life, number of visits to the emergency department and number of admissions to hospital. Two reviewers identified studies for inclusion in our meta-analysis. We extracted data and used fixedeffect modelling for the meta-analyses. **RESULTS:** We identified 21 randomized controlled trials for inclusion in our analysis. The methods of telehealthcare intervention these studies investigated were the telephone and video- and Internet-based models of care. Meta-analysis did not show a clinically important improvement in patients' quality of life, and there was no significant change in the number of visits to the emergency department over 12 months. There was a significant reduction in the number of patients admitted to hospital

once or more over 12 months (risk ratio 0.25 [95% confidence interval 0.09 to 0.66]).

INTERPRETATION: We found no evidence of a clinically important impact on patients' quality of life, but telehealthcare interventions do appear to have the potential to reduce the risk of admission to hospital, particularly for patients with severe asthma. Further research is required to clarify the cost-effectiveness of models of care based on telehealthcare.

McLean, S., Nurmatov, U., Liu, J. L., et al. (2012). "Telehealthcare for chronic obstructive pulmonary disease: Cochrane Review and meta-analysis." *Br J Gen Pract* **62**(604): e739-749.

BACKGROUND: Chronic obstructive pulmonary disease (COPD) is common. Telehealthcare, involving personalised health care over a distance, is seen as having the potential to improve care for people with COPD. AIM: To systematically review the effectiveness of telehealthcare interventions in COPD to improve clinical and process outcomes. DESIGN AND SETTING: Cochrane Systematic Review of randomised controlled trials. METHODS: The study involved searching the Cochrane Airways Group Register of Trials, which is derived from the Cochrane Central Register of Controlled Trials, MEDLINE, embase, and CINAHL, as well as searching registers of ongoing and unpublished trials. Randomised controlled trials comparing a telehealthcare intervention with a control intervention in people with a clinical diagnosis of COPD were identified. The main outcomes of interest were quality of life and risk of emergency department visit, hospitalisation, and death. Two authors independently selected trials for inclusion and extracted data. Study quality was assessed using the Cochrane Collaboration's risk of bias method. Meta-analysis was undertaken using fixed effect and/or random effects modelling. RESULTS: Ten randomised controlled trials were included. Telehealthcare did not improve COPD quality of life: mean difference -6.57 (95% confidence interval [CI] = -13.62 to 0.48). However, there was a significant reduction in the odds ratios (ORs) of emergency department attendance (OR = 0.27; 95% CI = 0.11 to 0.66) and hospitalisation (OR = 0.46; 95% CI = 0.33 to 0.65). There was a non-significant change in the OR of death (OR = 1.05; 95% CI = 0.63 to 1.75). CONCLUSION: In COPD, telehealthcare interventions can significantly reduce the risk of emergency department attendance and hospitalisation, but has little effect on the risk of death.

Meyer, T. D., Casarez, R., Mohite, S. S., et al. (2018). "Novel technology as platform for interventions for caregivers and individuals with severe mental health illnesses: A systematic review." *J Affect Disord* **226**: 169-177.

BACKGROUND: Severe mental illnesses (SMIs) have been found to be associated with both increases in morbidity-mortality, need for treatment care in patients themselves, and burden for relatives as caregivers. A growing number of web-based and mobile software applications have appeared that aim to address various barriers with respect to access to care. Our objective was to review and summarize recent advancements in such interventions for caregivers of individuals with a SMI. METHODS: We conducted a systematic search for papers evaluating interactive mobile or web-based software (using no or only minimal support from a professional) specifically aimed at supporting informal caregivers. We also searched for those supporting patients with SMI so as to not to miss any which might include relatives. RESULTS: Out of a total of 1673 initial hits, we identified 11 articles reporting on 9 different mobile or web-based software programs. The main result is that none of those studies focused on caregivers, and the ones we identified using mobile or web-based applications were just for patients and not their relatives. LIMITATIONS: Differentiating between online and offline available software might not always have been totally reliable, and we might have therefore missed some studies. CONCLUSIONS: In summary, the studies provided evidence that remotely accessible interventions for patients with SMI are feasible and acceptable to patients. No such empirically evaluated program was available for informal caregivers such

as relatives. Keeping in mind the influential role of those informal caregivers in the process of treatment and self-management, this is highly relevant for public health. Supporting informal caregivers can improve well-being of both caregivers and patients.

Miles, C., Arden-Close, E., Thomas, M., et al. (2017). "Barriers and facilitators of effective self-management in asthma: systematic review and thematic synthesis of patient and healthcare professional views." *NPJ Prim Care Respir Med* **27**(1): 57.

Self-management is an established, effective approach to controlling asthma, recommended in guidelines. However, promotion, uptake and use among patients and health-care professionals remain low. Many barriers and facilitators to effective self-management have been reported, and views and beliefs of patients and health care professionals have been explored in qualitative studies. We conducted a systematic review and thematic synthesis of qualitative research into self-management in patients, carers and health care professionals regarding self-management of asthma, to identify perceived barriers and facilitators associated with reduced effectiveness of asthma self-management interventions. Electronic databases and guidelines were searched systematically for qualitative literature that explored factors relevant to facilitators and barriers to uptake, adherence, or outcomes of self-management in patients with asthma. Thematic synthesis of the 56 included studies identified 11 themes: (1) partnership between patient and health care professional; (2) issues around medication; (3) education about asthma and its management; (4) health beliefs; (5) self-management interventions; (6) co-morbidities (7) mood disorders and anxiety; (8) social support; (9) non-pharmacological methods; (10) access to healthcare; (11) professional factors. From this, perceived barriers and facilitators were identified at the level of individuals with asthma (and carers), and health-care professionals. Future work addressing the concerns and beliefs of adults, adolescents and children (and carers) with asthma, effective communication and partnership, tailored support and education (including for ethnic minorities and at risk groups), and telehealthcare may improve how self-management is recommended by professionals and used by patients. Ultimately, this may achieve better outcomes for people with asthma.

Mohammadi, R., Ayatollahi Tafti, M., Hoveidamanesh, S., et al. (2018). "Reflection on Mobile Applications for Blood Pressure Management: A Systematic Review on Potential Effects and Initiatives." *Stud Health Technol Inform* **247**: 306-310.

INTRODUCTION: Ischemic heart disease and stroke have been considered as the first global leading cause of death in last decades [1]. Blood pressure (BP) management is one of the easiest ways suggested for preventing and controlling cardiovascular diseases before the patient develops complications and death-following outcomes. Appearance of technology advancements in the health system has motivated researchers and health providers to study its different aspects and applications in order to improve disease prevention and management. Following these efforts, mobile health (mHealth) technologies were presented to provide people with fast and easier-to-use services. Although there are some unsolved challenges, these technologies have become popular among many people. As an important part of mHealth, mobile applications (apps) have been the focused subject of many studies in the last decade. The objective of this systematic review is to assess the potential effects of mobile apps designed for BP management by scrutinizing the related studies. MATERIALS AND METHODS: Search methods: We searched the following electronic databases in December 2016: Medline (PubMed), National Center for Biotechnology Information (NCBI), Cochrane Central Register of Controlled Trials (CENTRAL), PsycINFO, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Education Resources Information Center(ERIC), Web of Science, ProQuest, and Google Scholar. No language restriction and

start point limitation were imposed. **SELECTION CRITERIA:** We included studies that evaluated and assessed mobile apps for BP management and related clinical trials that considered mobile app as the only difference between intervention and control groups. **DATA COLLECTION AND ANALYSIS:** Two review authors applied the eligibility criteria, extracted data and assessed the quality of included studies. **RESULTS:** Literature search resulted in 13 included studies and 27 reviews. 12 records of 13 included studies identified as interventional studies. The review showed that the mobile apps may improve individual's BP condition and medication adherence. **CONCLUSION:** Most of the studies had emphasized positive effects of mobile apps in BP management. However, there is a necessity for performing further investigations due to the identified issues in this study such as low number of participants and limited intervention period in randomized controlled trials, and interventions limited to only hypertensive or high-risked individual.

Moradian, S., Voelker, N., Brown, C., et al. (2018). "Effectiveness of Internet-based interventions in managing chemotherapy-related symptoms in patients with cancer: a systematic literature review." Support Care Cancer **26**(2): 361-374.

PURPOSE: The aims of this review were to (1) examine the effectiveness of Internet-based interventions on cancer chemotherapy-related physical symptoms (severity and/or distress) and health-related quality of life (HRQOL) outcomes and (2) identify the design elements and processes for implementing these interventions in oncology practices. **METHODS:** A systematic review was performed. The Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials, EMBASE, MEDLINE, CINAHL, and PsycINFO were searched for studies dating from January 2000 through to October 2016. Based on pre-determined selection criteria, data was extracted from eligible studies. Methodological quality of studies was assessed using an adapted version of the Cochrane Collaboration Back Review Group checklist. **RESULTS:** The literature search yielded 1766 studies of which only six RCTs fulfilled the eligibility criteria. Although the content, duration, and frequency of interventions varied considerably across studies, commonly used elements included tailored information, education, self-management support, and communication with clinicians. Five studies measured symptom distress and four of them reported statistically significant differences between study groups. Of the three studies that measured HRQOL, two reported improvement (or no deterioration over time) for the intervention group. However, several methodological issues including high attrition rates, poor adherence to interventions, and use of non-validated measures affect confidence in the strength of evidence. **CONCLUSION:** Despite the evidence in support of using the Internet as a worthwhile tool for effective patient engagement and self-management of chemotherapy-related symptoms outside clinic visits, methodological limitations in the evidence base require further well-planned and quality research.

Muellmann, S., Forberger, S., Mollers, T., et al. (2018). "Effectiveness of eHealth interventions for the promotion of physical activity in older adults: A systematic review." Prev Med **108**: 93-110.

Regular physical activity (PA) is central to healthy ageing. However, only a minority of older adults currently meet the WHO-recommended PA levels. The aim of this systematic review is to compare the effectiveness of eHealth interventions promoting PA in older adults aged 55 years and above with either no intervention or a non-eHealth intervention (review registration: PROSPERO CRD42015023875). Eight electronic databases were searched to identify experimental and quasi-experimental studies examining the effectiveness of eHealth interventions for PA promotion in adults aged 55 years and above. Two authors independently selected and reviewed references, extracted data, and assessed study quality. In the search, 5771 records were retrieved, 20 studies met all inclusion criteria. Studies

varied greatly in intervention mode, content, duration and assessed outcomes. Study quality ranged from poor to moderate. All interventions comprised tailored PA advice and the majority of interventions included goal setting and feedback, as well as PA tracking. Participation in eHealth interventions to promote PA led to increased levels of PA in adults aged 55years and above when compared to no intervention control groups, at least in the short term. However, the results were inconclusive regarding the question of whether eHealth interventions have a greater impact on PA behavior among older adults than non-eHealth interventions (e.g., print interventions). eHealth interventions can effectively promote PA in older adults aged 55years and above in the short-term, while evidence regarding long-term effects and the added benefit of eHealth compared to non-eHealth intervention components is still lacking.

Murphie, P., Little, S., McKinstry, B., et al. (2019). "Remote consulting with telemonitoring of continuous positive airway pressure usage data for the routine review of people with obstructive sleep apnoea hypopnoea syndrome: A systematic review." *J Telemed Telecare* **25**(1): 17-25.

INTRODUCTION: Telehealth has the potential to offer more convenient care and reduce travel. We aimed to systematically review studies that assessed the effectiveness of teleconsultation plus telemonitoring in the review of people with obstructive sleep apnoea hypopnoea syndrome receiving continuous positive airway pressure therapy versus face-to-face care. **METHODS:** Following Cochrane methodology, we searched 10 electronic databases (November 2015), trial registries, and reference lists of included studies, for trials testing interventions that combined remote consultations with telemonitoring of usage/continuous positive airway pressure data. Outcomes measures were: proportion reviewed, continuous positive airway pressure adherence, symptom control, and satisfaction/acceptability and cost effectiveness. **RESULTS:** From 362 potentially relevant papers, we identified five randomised controlled trials (n = 269 patients): four from North America and one from Spain. Risk of bias was moderate in one, and moderate/high in four trials. Two trials reported number/duration of reviews with inconsistent results. The teleconsultation/telemonitoring improved continuous positive airway pressure adherence in two trials (n = 19; n = 75); two (n = 114 and n = 75) reported no between-groups differences. Two studies, both at moderate/high risk of bias, showed no between-group difference in the Epworth Sleepiness Score. Satisfaction was generally reported positively in all five trials; one trial reported that the teleconsultation/telemonitoring patients were 'more likely to continue' with continuous positive airway pressure therapy treatment. One study reported teleconsultation/telemonitoring as cost effective. **DISCUSSION:** The evidence for teleconsultation/telemonitoring in continuous positive airway pressure users is limited; however, no safety concerns have been raised. Adequately powered, well-designed trials are needed to establish whether real-time telemonitoring and remote teleconsultation is a clinically and cost effective option for people using continuous positive airway pressure therapy.

Nangalia, V., Prytherch, D. R. et Smith, G. B. (2010). "Health technology assessment review: remote monitoring of vital signs--current status and future challenges." *Crit Care* **14**(5): 233.

Recent developments in communications technologies and associated computing and digital electronics now permit patient data, including routine vital signs, to be surveyed at a distance. Remote monitoring, or telemonitoring, can be regarded as a subdivision of telemedicine - the use of electronic and telecommunications technologies to provide and support health care when distance separates the participants. Depending on environment and purpose, the patient and the carer/system surveying, analysing or interpreting the data could be separated by as little as a few feet or be on different continents. Most

telemonitoring systems will incorporate five components: data acquisition using an appropriate sensor; transmission of data from patient to clinician; integration of data with other data describing the state of the patient; synthesis of an appropriate action, or response or escalation in the care of the patient, and associated decision support; and storage of data. Telemonitoring is currently being used in community-based healthcare, at the scene of medical emergencies, by ambulance services and in hospitals. Current challenges in telemonitoring include: the lack of a full range of appropriate sensors, the bulk weight and size of the whole system or its components, battery life, available bandwidth, network coverage, and the costs of data transmission via public networks. Telemonitoring also has the ability to produce a mass of data - but this requires interpretation to be of clinical use and much necessary research work remains to be done.

Nicholl, B. I., Sandal, L. F., Stochkendahl, M. J., et al. (2017). "Digital Support Interventions for the Self-Management of Low Back Pain: A Systematic Review." *J Med Internet Res* **19**(5): e179.

BACKGROUND: Low back pain (LBP) is a common cause of disability and is ranked as the most burdensome health condition globally. Self-management, including components on increased knowledge, monitoring of symptoms, and physical activity, are consistently recommended in clinical guidelines as cost-effective strategies for LBP management and there is increasing interest in the potential role of digital health. **OBJECTIVE:** The study aimed to synthesize and critically appraise published evidence concerning the use of interactive digital interventions to support self-management of LBP. The following specific questions were examined: (1) What are the key components of digital self-management interventions for LBP, including theoretical underpinnings? (2) What outcome measures have been used in randomized trials of digital self-management interventions in LBP and what effect, if any, did the intervention have on these? and (3) What specific characteristics or components, if any, of interventions appear to be associated with beneficial outcomes? **METHODS:** Bibliographic databases searched from 2000 to March 2016 included Medline, Embase, CINAHL, PsycINFO, Cochrane Library, DoPHer and TRoPHI, Social Science Citation Index, and Science Citation Index. Reference and citation searching was also undertaken. Search strategy combined the following concepts: (1) back pain, (2) digital intervention, and (3) self-management. Only randomized controlled trial (RCT) protocols or completed RCTs involving adults with LBP published in peer-reviewed journals were included. Two reviewers independently screened titles and abstracts, full-text articles, extracted data, and assessed risk of bias using Cochrane risk of bias tool. An independent third reviewer adjudicated on disagreements. Data were synthesized narratively. **RESULTS:** Of the total 7014 references identified, 11 were included, describing 9 studies: 6 completed RCTs and 3 protocols for future RCTs. The completed RCTs included a total of 2706 participants (range of 114-1343 participants per study) and varied considerably in the nature and delivery of the interventions, the duration/definition of LBP, the outcomes measured, and the effectiveness of the interventions. Participants were generally white, middle aged, and in 5 of 6 RCT reports, the majority were female and most reported educational level as time at college or higher. Only one study reported between-group differences in favor of the digital intervention. There was considerable variation in the extent of reporting the characteristics, components, and theories underpinning each intervention. None of the studies showed evidence of harm. **CONCLUSIONS:** The literature is extremely heterogeneous, making it difficult to understand what might work best, for whom, and in what circumstances. Participants were predominantly female, white, well educated, and middle aged, and thus the wider applicability of digital self-management interventions remains uncertain. No information on cost-effectiveness was reported. The evidence base for interactive digital interventions to support patient self-management of LBP remains weak.

Nordheim, L. V., Haavind, M. T. et Iversen, M. M. (2014). "Effect of telemedicine follow-up care of leg and foot ulcers: a systematic review." *BMC Health Serv Res* **14**: 565.

BACKGROUND: Leg ulcers and diabetes-related foot ulcers are frequent and costly complications of their underlying diseases and thus represent a critical issue for public health. Since the population is aging, the prevalence of these conditions will probably increase considerably and require more resources. Treatment of leg and foot ulcers often demands frequent contact with the health care system, may pose great burden on the patient, and involves follow-up in both primary and specialist care. Telemedicine provides potential for more effective care management of leg and foot ulcers. The objective of this systematic review of the literature was to assess the effect of telemedicine follow-up care on clinical, behavioral or organizational outcomes among patients with leg and foot ulcers. **METHODS:** We searched Ovid MEDLINE (1980-), Ovid EMBASE (1980-), Clinical Trials in the Cochrane Library (via Wiley), Ebsco CINAHL with Fulltext (1981-) and SveMed + (1977-) up to May 2014 for relevant articles. We considered randomized controlled trials, non-randomized trials, controlled before-after studies and prospective cohort studies for inclusion and selected studies according to predefined criteria. Three reviewers independently assessed the included studies using the Cochrane Collaboration risk-of-bias tool. We performed a narrative synthesis of results and assessed the strength of evidence for each outcome using GRADE (grading of recommendations, assessment, development and evaluation). **RESULTS:** Only one non-randomized study was included. The study (n = 140) measured the effect of real-time interactive video consultation compared with face-to-face follow-up on healing time, adjusted healing ratio and the number of ulcers at 12 weeks among patients with neuropathic forefoot ulcerations. There were no statistically significant differences in results of the different outcomes between patients receiving telemedicine and traditional follow-up. We assessed the study to have a high risk of bias. **CONCLUSIONS:** There is insufficient evidence available to unambiguously determine whether telemedicine consultation of leg and foot ulcers is as effective as traditional follow-up.

Nordio, S., Innocenti, T., Agostini, M., et al. (2018). "The efficacy of telerehabilitation in dysphagic patients: a systematic review." *Acta Otorhinolaryngol Ital* **38**(2): 79-85.

SUMMARY: Telerehabilitation is the use of telecommunications technology for rehabilitation. Recently, some studies have shown positive effects of telerehabilitation of swallowing disorders, yet there are no systematic reviews verifying the evidence. The aim of this review is to assess the effects of telerehabilitation in the field of dysphagia as an alternative to face-to-face patient care, considering swallowing recovery and/or quality of life in different patient populations. We searched the Cochrane Library, MEDLINE, EMBASE, Google Scholar, Google Search and the grey literature from inception until December 2016 for publications written in English (keywords: telerehabilitation, telemedicine, dysphagia, swallowing disorders), which resulted in 330 records. Abstract screening and data extraction was carried out independently by two reviewers. Four papers were selected to read in full, and the methodological quality of the studies included was evaluated using Cochrane Collaboration's tool for assessing risk of bias. One study met our inclusion criteria (Wall et al. 2016), which showed that telerehabilitation improves adherence to treatment compared to patient-directed intervention. Although adherence is an important factor that influences the treatment outcome, clinical outcomes have to be examined in randomised controlled trials in order to reach evidence in this field. Lastly, this systematic review did not demonstrate the efficacy of telerehabilitation compared with face-to face therapy.

O'Connor, M., Munnely, A., Whelan, R., et al. (2018). "The Efficacy and Acceptability of Third-Wave Behavioral and Cognitive eHealth Treatments: A Systematic Review and Meta-Analysis of Randomized Controlled Trials." *Behav Ther* **49**(3): 459-475.

eHealth is an innovative method of delivering therapeutic content with the potential to improve access to third-wave behavioral and cognitive therapies. This systematic review and meta-analysis aimed to determine the efficacy and acceptability of third-wave eHealth treatments in improving mental health outcomes. A comprehensive search of electronic bibliographic databases including PubMed, PsycINFO, Web of Science, and CENTRAL was conducted to identify randomized controlled trials of third-wave treatments in which eHealth was the main component. Twenty-one studies were included in the review. Meta-analyses revealed that third-wave eHealth significantly outperformed inactive control conditions in improving anxiety, depression, and quality-of-life outcomes and active control conditions in alleviating anxiety and depression with small to medium effect sizes. No statistically significant differences were found relative to comparison interventions. Findings from a narrative synthesis of participant evaluation outcomes and meta-analysis of participant attrition rates provided preliminary support for the acceptability of third-wave eHealth. Third-wave eHealth treatments are efficacious in improving mental health outcomes including anxiety, depression, and quality of life, but not more so than comparison interventions. Preliminary evidence from indices of participant evaluation and attrition rates supports the acceptability of these treatments.

Oliver, D. P., Demiris, G., Wittenberg-Lyles, E., et al. (2012). "A systematic review of the evidence base for telehospice." *Telemed J E Health* **18**(1): 38-47.

Abstract The use of telehealth technologies to overcome the geographic distances in the delivery of hospice care has been termed telehospice. Although telehospice research has been conducted over the last 10 years, little is known about the comprehensive findings within the field. The purpose of this systematic article was to focus on available research and answer the question, What is the state of the evidence related to telehospice services? The article was limited to studies that had been published in the English language and indexed between January 1, 2000 and March 23, 2010. Indexed databases included PubMed and PsycINFO and contained specified key words. Only research published in peer review journals and reporting empirical data, rather than opinion or editorials, were included. A two-part scoring framework was modified and applied to assess the methodological rigor and pertinence of each study. Scoring criteria allowed the evaluation of both quantitative and qualitative methodologies. Twenty-six studies were identified with the search strategy. Although limited in number and in strength, studies have evaluated the use of a variety of technologies, attitudes toward use by providers and consumers, clinical outcomes, barriers, readiness, and cost. A small evidence base for telehospice has emerged over the last 10 years. Although the evidence is of medium strength, its pertinence is strong. The evidence base could be strengthened with randomized trials and additional clinical-outcome-focused research in larger randomized samples and in qualitative studies with better-described samples.

Olsen, R., Bihlet, A. R., Kalakou, F., et al. (2016). "The impact of clinical trial monitoring approaches on data integrity and cost--a review of current literature." *Eur J Clin Pharmacol* **72**(4): 399-412.

PURPOSE: Monitoring is a costly requirement when conducting clinical trials. New regulatory guidance encourages the industry to consider alternative monitoring methods to the traditional 100 % source data verification (SDV) approach. The purpose of this literature review is to provide an overview of publications on different monitoring methods and their

impact on subject safety data, data integrity, and monitoring cost. METHODS: The literature search was performed by keyword searches in MEDLINE and hand search of key journals. All publications were reviewed for details on how a monitoring approach impacted subject safety data, data integrity, or monitoring costs. RESULTS: Twenty-two publications were identified. Three publications showed that SDV has some value for detection of not initially reported adverse events and centralized statistical monitoring (CSM) captures atypical trends. Fourteen publications showed little objective evidence of improved data integrity with traditional monitoring such as 100 % SDV and sponsor queries as compared to reduced SDV, CSM, and remote monitoring. Eight publications proposed a potential for significant cost reductions of monitoring by reducing SDV without compromising the validity of the trial results. CONCLUSIONS: One hundred percent SDV is not a rational method of ensuring data integrity and subject safety based on the high cost, and this literature review indicates that reduced SDV is a viable monitoring method. Alternative methods of monitoring such as centralized monitoring utilizing statistical tests are promising alternatives but have limitations as stand-alone tools. Reduced SDV combined with a centralized, risk-based approach may be the ideal solution to reduce monitoring costs while improving essential data quality.

Olson, C. M. (2016). "Behavioral Nutrition Interventions Using e- and m-Health Communication Technologies: A Narrative Review." *Annu Rev Nutr* **36**: 647-664.

e- and m-Health communication technologies are now common approaches to improving population health. The efficacy of behavioral nutrition interventions using e-health technologies to decrease fat intake and increase fruit and vegetable intake was demonstrated in studies conducted from 2005 to 2009, with approximately 75% of trials showing positive effects. By 2010, an increasing number of behavioral nutrition interventions were focusing on body weight. The early emphasis on interventions that were highly computer tailored shifted to personalized electronic interventions that included weight and behavioral self-monitoring as key features. More diverse target audiences began to participate, and mobile components were added to interventions. Little progress has been made on using objective measures rather than self-reported measures of dietary behavior. A challenge for nutritionists is to link with the private sector in the design, use, and evaluation of the many electronic devices that are now available in the marketplace for nutrition monitoring and behavioral change.

Pandor, A., Gomersall, T., Stevens, J. W., et al. (2013). "Remote monitoring after recent hospital discharge in patients with heart failure: a systematic review and network meta-analysis." *Heart* **99**(23): 1717-1726.

CONTEXT: Readmission to hospital for heart failure is common after recent discharge. Remote monitoring (RM) strategies have the potential to deliver specialised care and management and may be one way to meet the growing needs of the heart failure population. OBJECTIVE: To determine whether RM strategies improve outcomes for adults who have been recently discharged (<28 days) following an unplanned admission due to heart failure. STUDY DESIGN: Systematic review and network meta-analysis. DATA SOURCES: Fourteen electronic databases (including MEDLINE, EMBASE and PsycINFO) were searched to January 2012, and supplemented by hand-searching relevant articles. STUDY SELECTION: All randomised-controlled trials (RCTs) or observational cohort studies with a contemporaneous control group were included. RM interventions included home telemonitoring (TM) (including implanted monitoring devices) with medical support provided during office hours or 24/7 and structured telephone support (STS) programmes delivered via human-to-human contact (HH) or human-to-machine interface (HM). DATA EXTRACTION: Data were extracted

and validity was assessed independently by two reviewers. RESULTS: Twenty-one RCTs that enrolled 6317 patients were identified (11 studies evaluated STS (10 of which were HH, while 1 was HM), 9 studies assessed TM, and 1 study assessed both STS and TM). No trial of implanted monitoring devices met the inclusion criteria. Compared with usual care, although not reaching statistical significance, RM trended to reduce all-cause mortality for STS HH (HR: 0.77, 95% credible interval (CrI): 0.55, 1.08), TM during office hours (HR: 0.76, 95% CrI: 0.49, 1.18) and TM24/7 (HR: 0.49, 95% CrI: 0.20, 1.18). Exclusion of one trial that provided better-than-usual support to the control group rendered each of the above comparisons statistically significant. No beneficial effect on mortality was observed with STS HM. Reductions were also observed in all-cause hospitalisations for TM interventions but not for STS interventions. Care packages generally improved health-related quality-of-life and were acceptable to patients. CONCLUSIONS: STS HH and TM with medical support provided during office hours showed beneficial trends, particularly in reducing all-cause mortality for recently discharged patients with heart failure. Where 'usual' care is less good, the impact of RM is likely to be greater.

Pandor, A., Thokala, P., Gomersall, T., et al. (2013). "Home telemonitoring or structured telephone support programmes after recent discharge in patients with heart failure: systematic review and economic evaluation." *Health Technol Assess* **17**(32): 1-207, v-vi.

BACKGROUND: Remote monitoring (RM) strategies have the potential to deliver specialised care and management to patients with heart failure (HF). OBJECTIVE: To determine the clinical effectiveness and cost-effectiveness of home telemonitoring (TM) or structured telephone support (STS) strategies compared with usual care for adult patients who have been recently discharged (within 28 days) from acute care after a recent exacerbation of HF. DATA SOURCES: Fourteen electronic databases (including MEDLINE, EMBASE, PsycINFO and The Cochrane Library) and research registers were searched to January 2012, supplemented by hand-searching relevant articles and contact with experts. The review included randomised controlled trials (RCTs) or observational cohort studies with a contemporaneous control group that included the following RM interventions: (1) TM (including cardiovascular implanted monitoring devices) with medical support provided during office hours or 24/7; (2) STS programmes delivered by human-to-human contact (HH) or human-to-machine interface (HM). REVIEW METHODS: A systematic review and network meta-analysis (where appropriate) of the clinical evidence was carried out using standard methods. A Markov model was developed to evaluate the cost-effectiveness of different RM packages compared with usual care for recently discharged HF patients. TM 24/7 or using cardiovascular monitoring devices was not considered in the economic model because of the lack of data and/or unsuitability for the UK setting. Given the heterogeneity in the components of usual care and RM interventions, the cost-effectiveness analysis was performed using a set of costing scenarios designed to reflect the different configurations of usual care and RM in the UK. RESULTS: The literature searches identified 3060 citations. Six RCTs met the inclusion criteria and were added to the 15 trials identified from the previous systematic reviews giving a total of 21 RCTs included in the systematic review. No trials of cardiovascular implanted monitoring devices or observational studies met the inclusion criteria. The methodological quality of the studies varied widely and reporting was generally poor. Compared with usual care, RM was beneficial in reducing all-cause mortality for STS HH [hazard ratio (HR) 0.77, 95% credible interval (CrI) 0.55 to 1.08], TM during office hours (HR 0.76, 95% CrI 0.49 to 1.18) and TM 24/7 (HR 0.49, 95% CrI 0.20 to 1.18); however, these results were statistically inconclusive. The results for TM 24/7 should be treated with caution because of the poor methodological quality of the only included study in this network. No favourable effect on mortality was observed with STS HM. Similar reductions were observed in all-cause hospitalisations for TM interventions, whereas STS interventions had no major

effect. A sensitivity analysis, in which a study was excluded because it provided better-than-usual support to the control group, showed larger beneficial effects for most outcomes, particularly for TM during office hours. In the cost-effectiveness analyses, TM during office hours was the most cost-effective strategy with an estimated incremental cost-effectiveness ratio (ICER) of pound11,873 per quality-adjusted life-year (QALY) compared with usual care, whereas STS HH had an ICER of pound228,035 per QALY compared with TM during office hours. STS HM was dominated by usual care. Similar results were observed in scenario analyses performed using higher costs of usual care, higher costs of STS HH and lower costs of TM during office hours. LIMITATIONS: The RM interventions included in the review were heterogeneous in terms of monitored parameters and HF selection criteria and lacked detail in the components of the RM care packages and usual care (e.g. communication protocols, routine staff visits and resources used). As a result, the economic model developed scenarios for different RM classifications and their costs were estimated using bottom-up costing methods. Although the users can decide which of these scenarios is most representative of their setting, uncertainties still remain about the assumptions made in the estimation of these costs. In addition, the model assumed that the effectiveness of the interventions was constant over time, irrespective of the duration of deployment, and that the intervention was equally effective in different age/severity groups. CONCLUSION: Despite wide variation in usual care and RM strategies, cost-effectiveness analyses suggest that TM during office hours was an optimal strategy (in most costing scenarios). However, clarity was lacking among descriptions of the components of RM packages and usual care and there was a lack of robust estimation of costs. Further research is needed in these areas. STUDY REGISTRATION: PROSPERO registration no. CRD42011001368. FUNDING: The National Institute for Health Research Health Technology Assessment programme.

Parthiban, N., Esterman, A., Mahajan, R., et al. (2015). "Remote Monitoring of Implantable Cardioverter-Defibrillators: A Systematic Review and Meta-Analysis of Clinical Outcomes." J Am Coll Cardiol **65**(24): 2591-2600.

BACKGROUND: Remote monitoring (RM) of implantable cardioverter-defibrillators (ICD) is an established technology integrated into clinical practice. One recent randomized controlled trial (RCT) and several large device database studies have demonstrated a powerful survival advantage for ICD patients undergoing RM compared with those receiving conventional in-office (IO) follow-up. OBJECTIVES: This study sought to conduct a systematic published data review and meta-analysis of RCTs comparing RM with IO follow-up. METHODS: Electronic databases and reference lists were searched for RCTs reporting clinical outcomes in ICD patients who did or did not undergo RM. Data were extracted from 9 RCTs, including 6,469 patients, 3,496 of whom were randomized to RM and 2,973 to IO follow-up. RESULTS: In the RCT setting, RM demonstrated clinical outcomes comparable with office follow-up in terms of all-cause mortality (odds ratio [OR]: 0.83; $p = 0.285$), cardiovascular mortality (OR: 0.66; $p = 0.103$), and hospitalization (OR: 0.83; $p = 0.196$). However, a reduction in all-cause mortality was noted in the 3 trials using home monitoring (OR: 0.65; $p = 0.021$) with daily verification of transmission. Although the odds of receiving any ICD shock were similar in RM and IO patients (OR: 1.05; $p = 0.86$), the odds of inappropriate shock were reduced in RM patients (OR: 0.55; $p = 0.002$). CONCLUSIONS: Meta-analysis of RCTs demonstrates that RM and IO follow-up showed comparable overall outcomes related to patient safety and survival, with a potential survival benefit in RCTs using daily transmission verification. RM benefits include more rapid clinical event detection and a reduction in inappropriate shocks.

Pedone, C. et Lelli, D. (2015). "Systematic review of telemonitoring in COPD: an update." Pneumonol Alergol Pol **83**(6): 476-484.

Telemedicine may support individual care plans in people with chronic obstructive pulmonary disease (COPD), potentially improving the clinical outcomes. To-date there is no clear evidence of benefit of telemedicine in this patients. The aim of this study is to provide an update on the effectiveness of telemedicine in reducing adverse clinical outcomes. We searched the Pubmed database for articles published between January 2005 and December 2014. We included only randomized controlled trials exclusively focused on patients with COPD and with a telemedicine intervention arm. Evaluated outcomes were number of exacerbations, ER visits, COPD hospitalizations, length of stay and death. We eventually included 12 randomized controlled trials. Most of them had a small sample size and was of poor quality, with a wide heterogeneity in the parameters and technologies used. Most studies reported a positive effect of telemonitoring on hospitalization for any cause, with risk reductions between 10% and 63%; however only three studies reached statistical significance. The same trend was observed for COPD-related hospital admission and ER visits. No significant effects of telemedicine was evidenced in reducing length of hospital stay, improving quality of life and reducing deaths. In conclusion, our study confirms that the available evidence on the effectiveness of telemedicine in COPD does not allow to draw definite conclusions; most evidence suggests a positive effect of telemonitoring on hospital admissions and ER visits. More trials with adequate sample size and with adequate consideration of background clinical services are needed to definitively establish its effectiveness.

Peek, S. T., Wouters, E. J., van Hoof, J., et al. (2014). "Factors influencing acceptance of technology for aging in place: a systematic review." *Int J Med Inform* **83**(4): 235-248.

PURPOSE: To provide an overview of factors influencing the acceptance of electronic technologies that support aging in place by community-dwelling older adults. Since technology acceptance factors fluctuate over time, a distinction was made between factors in the pre-implementation stage and factors in the post-implementation stage. **METHODS:** A systematic review of mixed studies. Seven major scientific databases (including MEDLINE, Scopus and CINAHL) were searched. Inclusion criteria were as follows: (1) original and peer-reviewed research, (2) qualitative, quantitative or mixed methods research, (3) research in which participants are community-dwelling older adults aged 60 years or older, and (4) research aimed at investigating factors that influence the intention to use or the actual use of electronic technology for aging in place. Three researchers each read the articles and extracted factors. **RESULTS:** Sixteen out of 2841 articles were included. Most articles investigated acceptance of technology that enhances safety or provides social interaction. The majority of data was based on qualitative research investigating factors in the pre-implementation stage. Acceptance in this stage is influenced by 27 factors, divided into six themes: concerns regarding technology (e.g., high cost, privacy implications and usability factors); expected benefits of technology (e.g., increased safety and perceived usefulness); need for technology (e.g., perceived need and subjective health status); alternatives to technology (e.g., help by family or spouse), social influence (e.g., influence of family, friends and professional caregivers); and characteristics of older adults (e.g., desire to age in place). When comparing these results to qualitative results on post-implementation acceptance, our analysis showed that some factors are persistent while new factors also emerge. Quantitative results showed that a small number of variables have a significant influence in the pre-implementation stage. Fourteen out of the sixteen included articles did not use an existing technology acceptance framework or model. **CONCLUSIONS:** Acceptance of technology in the pre-implementation stage is influenced by multiple factors. However, post-implementation research on technology acceptance by community-dwelling older adults is scarce and most of the factors in this review have not been tested by using quantitative

methods. Further research is needed to determine if and how the factors in this review are interrelated, and how they relate to existing models of technology acceptance.

Peetoom, K. K., Lexis, M. A., Joore, M., et al. (2015). "Literature review on monitoring technologies and their outcomes in independently living elderly people." *Disabil Rehabil Assist Technol* **10**(4): 271-294.

PURPOSE: To obtain insight into what kind of monitoring technologies exist to monitor activity in-home, what the characteristics and aims of applying these technologies are, what kind of research has been conducted on their effects and what kind of outcomes are reported. **METHODS:** A systematic document search was conducted within the scientific databases Pubmed, Embase, Cochrane, PsycINFO and Cinahl, complemented by Google Scholar. Documents were included in this review if they reported on monitoring technologies that detect activities of daily living (ADL) or significant events, e.g. falls, of elderly people in-home, with the aim of prolonging independent living. **RESULTS:** Five main types of monitoring technologies were identified: PIR motion sensors, body-worn sensors, pressure sensors, video monitoring and sound recognition. In addition, multicomponent technologies and smart home technologies were identified. Research into the use of monitoring technologies is widespread, but in its infancy, consisting mainly of small-scale studies and including few longitudinal studies. **CONCLUSIONS:** Monitoring technology is a promising field, with applications to the long-term care of elderly persons. However, monitoring technologies have to be brought to the next level, with longitudinal studies that evaluate their (cost-) effectiveness to demonstrate the potential to prolong independent living of elderly persons. [Box: see text].

Pekmezaris, R., Tortez, L., Williams, M., et al. (2018). "Home Telemonitoring In Heart Failure: A Systematic Review And Meta-Analysis." *Health Aff (Millwood)* **37**(12): 1983-1989.

We conducted a meta-analysis of twenty-six randomized controlled trials that tested the effectiveness of home telemonitoring in patients with heart failure for reducing mortality and hospital use. We used the PICOT framework as a tool to address an important variable not previously studied: the timing or duration of monitoring. Specifically, we found that home telemonitoring decreased the odds of all-cause mortality and heart failure-related mortality at 180 days but not at 365 days. Home telemonitoring did not significantly affect the odds of all-cause hospitalization at 90 or 180 days, or of heart failure-related hospitalization at 180 days. At 180 days, home telemonitoring significantly increased the odds of all-cause emergency department visits. Home care provision did not moderate the effects of home telemonitoring on all-cause hospitalization. Recent regulatory changes that relaxed Medicare restrictions on telehealth reimbursement make it imperative that studies fully describe outcomes (for example, heart failure-related versus all-cause hospitalizations) and deliberately test all essential intervention elements, such as intervention duration.

Peterson, A. (2014). "Improving type 1 diabetes management with mobile tools: a systematic review." *J Diabetes Sci Technol* **8**(4): 859-864.

This study aims to provide a better understanding of the ability of mobile health tools to offer glycemic control for patients with type 1 diabetes mellitus. Data gained from research articles searched in PubMed, Ovid (Medline), and CINAHL from 2005 to 2013 focused on interventions introduced to a type 1 diabetic population. Articles were screened to identify interventions that examined mobile health tools effect on glycemic control using %A1C as a proxy. Fourteen articles were included in this study. Descriptive data, %A1C difference, and statistical significance, if available, were extracted for comparison. Five major categories

were identified across the spectrum of interventions, including "Internet," "Mobile," "Mobile and Internet," "Phone," and "Videoconference and phone." Seven of the 14 articles reported statistically significant decreases in measured outcomes. Seven studies examine a single cohort, and 7 examined a double cohort. Eleven of the 14 authors (79%) reported success with their intervention. Twelve studies reported a decrease in %A1C values in their intervention groups. Initial results for glycemic control through these tools appear promising, though inconclusive. Additional measures of mobile health tool efficacy should be assessed more directly. More rigorous study methods are also needed to improve the reliability of results.

Piga, M., Cangemi, I., Mathieu, A., et al. (2017). "Telemedicine for patients with rheumatic diseases: Systematic review and proposal for research agenda." *Semin Arthritis Rheum* **47**(1): 121-128.

OBJECTIVE: To systematically review the scientific literature regarding tele-rheumatology and draw conclusions about feasibility, effectiveness, and patient satisfaction. **METHODS:** PubMed, Scopus, and Cochrane database searches were performed (April 2016) using relevant MeSH and keyword terms for telemedicine and rheumatic diseases. Articles were selected if reporting outcomes for feasibility, effectiveness, and patient satisfaction and methodologically appraised using the Cochrane Collaboration's tool for assessing risk of bias and a modified version of CONSORT 2010 Statement. **RESULTS:** A total of 177 articles were screened, 23 were selected for the present review but only 9 were RCTs. Five studies reported on feasibility, 14 effectiveness, and 9 satisfaction rates for different tele-rheumatology interventions grouped in synchronous (remotely delivered consultation) and asynchronous (remote disease activity assessment; tele-monitoring of treatment strategies or rehabilitation; and remotely delivered self-management programs). Seven studies (30.4%) were on rheumatoid arthritis, 2 (8.7%) were on systemic sclerosis (1 including also rheumatoid arthritis patients), 5 (21.7%) on fibromyalgia, 2 (8.7%) on osteoarthritis, 3 (13.0%) on juvenile idiopathic arthritis and 4 (17.4%) on mixed disease cohorts. Interventions and outcomes heterogeneity prevented meta-analysis of results. Overall, feasibility and patient satisfaction rates were high or very high across intervention types. Effectiveness was equal or higher than standard face-to-face approach in controlled trials which, however, were affected by small sample size and lack of blinding participants according to appraisal tools. **CONCLUSION:** Telemedicine may provide a well-accepted way to remotely deliver consultation, treatment and monitoring disease activity in rheumatology. Higher quality RCTs demonstrating effectiveness of different tele-rheumatology interventions are needed.

Polisena, J., Tran, K., Cimon, K., et al. (2010). "Home telemonitoring for congestive heart failure: a systematic review and meta-analysis." *J Telemed Telecare* **16**(2): 68-76.

We conducted a systematic review of the literature about home telemonitoring compared with usual care. An electronic literature search was conducted to identify studies of home telemonitoring use in congestive heart failure (CHF) patients. Twenty-one original studies on home telemonitoring for patients with CHF were included (3082 patients). A random effects model was used to compute treatment efficacy to measure the average effect of the intervention across all studies where the quantitative pooling of results was appropriate. Home telemonitoring reduced mortality (risk ratio = 0.64; 95% CI: 0.48-0.85) compared with usual care. Several studies suggested that home telemonitoring also helped to lower the number of hospitalizations and the use of other health services. Patient quality of life and satisfaction with home telemonitoring were similar or better than with usual care. More studies of higher methodological quality are required to give more precise information about the potential clinical effectiveness of home telehealth interventions.

Roeing, K. L., Hsieh, K. L. et Sosnoff, J. J. (2017). "A systematic review of balance and fall risk assessments with mobile phone technology." Arch Gerontol Geriatr **73**: 222-226.

Falls are a major health concern for older adults. Preventative measures can help reduce the incidence and severity of falls. Methods for assessing balance and fall risk factors are necessary to effectively implement preventative measures. Research groups are currently developing mobile applications to enable seniors, caregivers, and clinicians to monitor balance and fall risk. The following systematic review assesses the current state of mobile health apps for testing balance as a fall risk factor. Thirteen studies were identified and included in the review and analyzed based on study design, population, sample size, measures of balance, main outcome measures, and evaluation of validity and reliability. All studies successfully tested their applications, but only 38% evaluated the validity, and 23% evaluated the reliability of their applications. Of those, all applications were found to accurately and reliably measure balance on select variables. Four of the 13 studies included special populations groups. Out of the 13 studies, 12 reported clinicians as their intended user and seven reported seniors as their intended user. Further research should examine the validity of mobile health applications as well as report on the application's usability.

Rosser, B. A., Vowles, K. E., Keogh, E., et al. (2009). "Technologically-assisted behaviour change: a systematic review of studies of novel technologies for the management of chronic illness." J Telemed Telecare **15**(7): 327-338.

A systematic review was conducted to investigate the use of technology in achieving behaviour change in chronic illness. The areas reviewed were: (1) methods employed to adapt traditional therapy from a face-to-face medium to a computer-assisted platform; (2) targets of behaviour change; and (3) level of human (e.g. therapist) involvement. The initial literature search produced 2032 articles. A total of 45 articles reporting 33 separate interventions met the inclusion/exclusion criteria and were reviewed in detail. The majority of interventions reported a theoretical basis, with many arising from a cognitive-behavioural framework. There was a wide range of therapy content. Therapist involvement was reported in 73% of the interventions. A common problem was high participant attrition, which may have been related to reduced levels of human interaction. Instigating successful behaviour change through technological interventions poses many difficulties. However, there are potential benefits of delivering therapy in this way. For people with long-term health conditions, technological self-management systems could provide a practical method of understanding and monitoring their condition, as well as therapeutic guidance to alter maladaptive behaviour.

Sarfo, F. S., Ulasavets, U., Opare-Sem, O. K., et al. (2018). "Tele-Rehabilitation after Stroke: An Updated Systematic Review of the Literature." J Stroke Cerebrovasc Dis **27**(9): 2306-2318.

BACKGROUND: Tele-rehabilitation for stroke survivors has emerged as a promising intervention for remotely supervised administration of physical, occupational, speech, and other forms of therapies aimed at improving motor, cognitive, and neuropsychiatric deficits from stroke. **OBJECTIVE:** We aimed to provide an updated systematic review on the efficacy of tele-rehabilitation interventions for recovery from motor, higher cortical dysfunction, and poststroke depression among stroke survivors. **METHODS:** We searched PubMed and Cochrane library from January 1, 1980 to July 15, 2017 using the following keywords: "Telerehabilitation stroke," "Mobile health rehabilitation," "Telemedicine stroke rehabilitation," and "Telerehabilitation." Our inclusion criteria were randomized controlled trials, pilot trials, or feasibility trials that included an intervention group that received any tele-rehabilitation therapy for stroke survivors compared with a control group on usual or

standard of care. RESULTS: This search yielded 49 abstracts. By consensus between 2 investigators, 22 publications met the criteria for inclusion and further review. Tele-rehabilitation interventions focused on motor recovery (n = 18), depression, or caregiver strain (n = 2) and higher cortical dysfunction (n = 2). Overall, tele-rehabilitation interventions were associated with significant improvements in recovery from motor deficits, higher cortical dysfunction, and depression in the intervention groups in all studies assessed, but significant differences between intervention versus control groups were reported in 8 of 22 studies in favor of tele-rehabilitation group while the remaining studies reported nonsignificant differences. CONCLUSION: This updated systematic review provides evidence to suggest that tele-rehabilitation interventions have either better or equal salutary effects on motor, higher cortical, and mood disorders compared with conventional face-to-face therapy.

Slattery, B. W., Haugh, S., Francis, K., et al. (2017). "Protocol for a systematic review with network meta-analysis of the modalities used to deliver eHealth interventions for chronic pain." *Syst Rev* 6(1): 45.

BACKGROUND: As eHealth interventions prove both efficacious and practical, and as they arguably overcome certain barriers encountered by traditional face-to-face treatment for chronic pain, their number has increased dramatically in recent times. However, there is a dearth of research that focuses on evaluating and comparing the different types of technology-assisted interventions. This is a protocol for a systematic review that aims to evaluate the eHealth modalities in the context of psychological and non-psychological (other than non-drug) interventions for chronic pain. METHODS/DESIGN: We will search the Cochrane Central Register of Controlled Trials (CENTRAL: The Cochrane Library), MEDLINE, Embase and PsycINFO. Randomised controlled trials (RCTs) with more than 20 participants per trial arm that have evaluated non-drug psychological or non-psychological interventions delivered via an eHealth modality and have pain as an outcome measure will be included. Two review authors will independently extract data and assess the study suitability in accordance with the Cochrane Collaboration Risk of Bias Tool. Studies will be included if they measure at least one outcome variable in accordance with the IMMPACT guidelines (i.e. pain severity, pain interference, physical functioning, symptoms, emotional functioning, global improvement and disposition). Secondary outcomes will be measures of depression and health-related quality of life (HRQoL). A network meta-analysis will be conducted based on direct comparisons to generate indirect comparisons of modalities across treatment trials, which will return rankings for the eHealth modalities in terms of their effectiveness. DISCUSSION: Most trials that use an eHealth intervention to manage chronic pain typically use one modality. As a result, little evidence exists to support which modality type is the most effective. The current review will address this gap in the literature and compare the different eHealth modalities used for technology-assisted interventions for chronic pain. With the growing reliance and use of technology as a medium for delivering treatment for chronic conditions more generally, it is imperative that research identify the most efficacious eHealth modalities and systematically identify the most important features of such treatment types, so they may be replicated and used for research and in the provision of care. TRIAL REGISTRATION: PROSPERO, CRD42016035595.

Sousa, V. E. C. et Dunn Lopez, K. (2017). "Towards Usable E-Health. A Systematic Review of Usability Questionnaires." *Appl Clin Inform* 8(2): 470-490.

BACKGROUND: The use of e-health can lead to several positive outcomes. However, the potential for e-health to improve healthcare is partially dependent on its ease of use. In order to determine the usability for any technology, rigorously developed and appropriate

measures must be chosen. OBJECTIVES: To identify psychometrically tested questionnaires that measure usability of e-health tools, and to appraise their generalizability, attributes coverage, and quality. METHODS: We conducted a systematic review of studies that measured usability of e-health tools using four databases (Scopus, PubMed, CINAHL, and HAPI). Non-primary research, studies that did not report measures, studies with children or people with cognitive limitations, and studies about assistive devices or medical equipment were systematically excluded. Two authors independently extracted information including: questionnaire name, number of questions, scoring method, item generation, and psychometrics using a data extraction tool with pre-established categories and a quality appraisal scoring table. RESULTS: Using a broad search strategy, 5,558 potentially relevant papers were identified. After removing duplicates and applying exclusion criteria, 35 articles remained that used 15 unique questionnaires. From the 15 questionnaires, only 5 were general enough to be used across studies. Usability attributes covered by the questionnaires were: learnability (15), efficiency (12), and satisfaction (11). Memorability (1) was the least covered attribute. Quality appraisal showed that face/content (14) and construct (7) validity were the most frequent types of validity assessed. All questionnaires reported reliability measurement. Some questionnaires scored low in the quality appraisal for the following reasons: limited validity testing (7), small sample size (3), no reporting of user centeredness (9) or feasibility estimates of time, effort, and expense (7). CONCLUSIONS: Existing questionnaires provide a foundation for research on e-health usability. However, future research is needed to broaden the coverage of the usability attributes and psychometric properties of the available questionnaires.

Stratton, E., Lampit, A., Choi, I., et al. (2017). "Effectiveness of eHealth interventions for reducing mental health conditions in employees: A systematic review and meta-analysis." *PLoS One* **12**(12): e0189904.

BACKGROUND: Many organisations promote eHealth applications as a feasible, low-cost method of addressing mental ill-health and stress amongst their employees. However, there are good reasons why the efficacy identified in clinical or other samples may not generalize to employees, and many Apps are being developed specifically for this group. The aim of this paper is to conduct the first comprehensive systematic review and meta-analysis evaluating the evidence for the effectiveness and examine the relative efficacy of different types of eHealth interventions for employees. METHODS: Systematic searches were conducted for relevant articles published from 1975 until November 17, 2016, of trials of eHealth mental health interventions (App or web-based) focused on the mental health of employees. The quality and bias of all identified studies was assessed. We extracted means and standard deviations from published reports, comparing the difference in effect sizes (Hedge's g) in standardized mental health outcomes. We meta-analysed these using a random effects model, stratified by length of follow up, intervention type, and whether the intervention was universal (unselected) or targeted to selected groups e.g. "stressed". RESULTS: 23 controlled trials of eHealth interventions were identified which overall suggested a small positive effect at both post intervention ($g = 0.24$, 95% CI 0.13 to 0.35) and follow up ($g = 0.23$, 95% CI 0.03 to 0.42). There were differential short term effects seen between the intervention types whereby Mindfulness based interventions ($g = 0.60$, 95% CI 0.34 to 0.85, $n = 6$) showed larger effects than the Cognitive Behaviour Therapy (CBT) based ($g = 0.15$, 95% CI 0.02 to 0.29, $n = 11$) and Stress Management based ($g = 0.17$, 95%CI -0.01 to 0.34, $n = 6$) interventions. The Stress Management interventions however differed by whether delivered to universal or targeted groups with a moderately large effect size at both post-intervention ($g = 0.64$, 95% CI 0.54 to 0.85) and follow-up ($g = 0.69$, 95% CI 0.06 to 1.33) in targeted groups, but no effect in unselected groups. INTERPRETATION: There is reasonable evidence that eHealth interventions delivered to employees may reduce mental health and stress symptoms post

intervention and still have a benefit, although reduced at follow-up. Despite the enthusiasm in the corporate world for such approaches, employers and other organisations should be aware not all such interventions are equal, many lack evidence, and achieving the best outcomes depends upon providing the right type of intervention to the correct population.

Talal, M., Zaidan, A. A., Zaidan, B. B., et al. (2019). "Smart Home-based IoT for Real-time and Secure Remote Health Monitoring of Triage and Priority System using Body Sensors: Multi-driven Systematic Review." *J Med Syst* **43**(3): 42.

The Internet of Things (IoT) has been identified in various applications across different domains, such as in the healthcare sector. IoT has also been recognised for its revolution in reshaping modern healthcare with aspiring wide range prospects, including economical, technological and social. This study aims to establish IoT-based smart home security solutions for real-time health monitoring technologies in telemedicine architecture. A multilayer taxonomy is driven and conducted in this study. In the first layer, a comprehensive analysis on telemedicine, which focuses on the client and server sides, shows that other studies associated with IoT-based smart home applications have several limitations that remain unaddressed. Particularly, remote patient monitoring in healthcare applications presents various facilities and benefits by adopting IoT-based smart home technologies without compromising the security requirements and potentially large number of risks. An extensive search is conducted to identify articles that handle these issues, related applications are comprehensively reviewed and a coherent taxonomy for these articles is established. A total number of (n = 3064) are gathered between 2007 and 2017 for most reliable databases, such as ScienceDirect, Web of Science and Institute of Electrical and Electronic Engineer Xplore databases. Then, the articles based on IoT studies that are associated with telemedicine applications are filtered. Nine articles are selected and classified into two categories. The first category, which accounts for 22.22% (n = 2/9), includes surveys on telemedicine articles and their applications. The second category, which accounts for 77.78% (n = 7/9), includes articles on the client and server sides of telemedicine architecture. The collected studies reveal the essential requirement in constructing another taxonomy layer and review IoT-based smart home security studies. Therefore, IoT-based smart home security features are introduced and analysed in the second layer. The security of smart home design based on IoT applications is an aspect that represents a crucial matter for general occupants of smart homes, in which studies are required to provide a better solution with patient security, privacy protection and security of users' entities from being stolen or compromised. Innovative technologies have dispersed limitations related to this matter. The existing gaps and trends in this area should be investigated to provide valuable visions for technical environments and researchers. Thus, 67 articles are obtained in the second layer of our taxonomy and are classified into six categories. In the first category, 25.37% (n = 17/67) of the articles focus on architecture design. In the second category, 17.91% (n = 12/67) includes security analysis articles that investigate the research status in the security area of IoT-based smart home applications. In the third category, 10.44% (n = 7/67) includes articles about security schemes. In the fourth category, 17.91% (n = 12/67) comprises security examination. In the fifth category, 13.43% (n = 9/67) analyses security protocols. In the final category, 14.92% (n = 10/67) analyses the security framework. Then, the identified basic characteristics of this emerging field are presented and provided in the following aspects. Open challenges experienced on the development of IoT-based smart home security are addressed to be adopted fully in telemedicine applications. Then, the requirements are provided to increase researcher's interest in this study area. On this basis, a number of recommendations for different parties are described to provide insights on the next steps that should be considered to enhance the security of smart homes based on IoT. A map matching for both taxonomies is developed in this study to determine the novel risks

and benefits of IoT-based smart home security for real-time remote health monitoring within client and server sides in telemedicine applications.

Timmermans, I., Meine, M., Zitron, E., et al. (2017). "The patient perspective on remote monitoring of patients with an implantable cardioverter defibrillator: Narrative review and future directions." *Pacing Clin Electrophysiol* **40**(7): 826-833.

BACKGROUND: Studies have shown that remote patient monitoring (RPM) of implantable cardioverter defibrillators (ICDs) is at least comparable to in-clinic follow-up with regard to clinical outcomes and might be cost-effective, yet RPM is not standard clinical practice within Europe. Better insight into the patient perspective on RPM may aid in its acceptance, implementation, and reimbursement. This narrative review (1) summarizes existing evidence on the impact of RPM on patient-reported outcomes and (2) discusses future directions in examining the patient perspective. **METHODS AND RESULTS:** Literature review indicated that only five randomized trials on RPM in ICD patients included patient-reported outcomes, with inconclusive results. Observational studies show a trend toward good patient satisfaction and acceptance of RPM. Yet, results should be interpreted with caution due to a number of limitations including a potential selection bias, use of generic/nonvalidated questionnaires, relatively short follow-up durations, and a lack of subgroup identification. **CONCLUSION:** Although RPM seems to be safe, effective, timely, and efficient, the patient perspective has received little attention so far. The scarce evidence on patient-reported outcomes in RPM studies seems to be positive, but future trials with a follow-up of ≥ 12 months and validated patient-reported outcome measures are needed. The REMOTE-CIED study from our group is the first prospective randomized controlled trial primarily designed to examine the patient perspective on RPM, and is powered to identify characteristics associated with RPM satisfaction and benefit. Results are expected in 2018 and will add valuable information to the current evidence.

Toma, T., Athanasiou, T., Harling, L., et al. (2014). "Online social networking services in the management of patients with diabetes mellitus: systematic review and meta-analysis of randomised controlled trials." *Diabetes Res Clin Pract* **106**(2): 200-211.

AIMS: Social networking services (SNS) can facilitate real-time communication and feedback of blood glucose and other physiological data between patients and healthcare professionals. This systematic review and meta-analysis aims to summarise the current evidence surrounding the role of online social networking services in diabetes care. **METHODS:** We performed a systematic literature review of the Medline, EMBASE and PsychINFO databases of all studies reporting HbA1c (glycated haemoglobin) as a measure of glycaemic control for social networking services in diabetes care. HbA1c, clinical outcomes and the type of technology used were extracted. Study quality and publication bias were assessed. **RESULTS:** SNS interventions beneficially reduced HbA1c when compared to controls, which was confirmed by sensitivity analysis. SNS interventions also significantly improved systolic and diastolic blood pressure, triglycerides and total cholesterol. Subgroup analysis according to diabetes type demonstrated that Type 2 diabetes patients had a significantly greater reduction in HbA1c than those with Type 1 diabetes. **CONCLUSIONS:** Online SNS provide a novel, feasible approach to improving glycaemic control, particularly in patients with Type 2 diabetes. Further mechanistic and cost-effectiveness studies are required to improve our understanding of SNS and its efficacy in diabetes care.

Urquhart, C. et Currell, R. (2010). "Home uterine monitoring: a case of telemedicine failure?" *Health Informatics J* **16**(3): 165-175.

The aim of the article is to explore and explain some of the controversies around home uterine monitoring, using a socio-technical interaction networks (STIN) approach. A Cochrane systematic review identified 15 included studies. A critique of these studies, using the eight components of the STIN framework, illustrated very clearly the different assumptions made about the purpose of home uterine monitoring, and helped to explain the different outcomes. The final mapping stage suggested that systems architecture choices included that of the role of monitoring support, to complement patient education or to enhance education for provider and patient. A similar choice concerned the type and extent of patient-care-provider contacts to be used. Using the STIN framework provided a useful perspective on the telemedicine aspects of home uterine monitoring, providing value beyond the systematic review conclusions alone.

van den Berg, N., Schumann, M., Kraft, K., et al. (2012). "Telemedicine and telecare for older patients--a systematic review." *Maturitas* **73**(2): 94-114.

Telemedicine is increasingly becoming a reality in medical care for the elderly. We performed a systematic literature review on telemedicine healthcare concepts for older patients. We included controlled studies in an ambulant setting that analyzed telemedicine interventions involving patients aged ≥ 60 years. 1585 articles matched the specified search criteria, thereof, 68 could be included in the review. Applications address an array of mostly frequent diseases, e.g. cardiovascular disease (N=37) or diabetes (N=18). The majority of patients is still living at home and is able to handle the telemedicine devices by themselves. In 59 of 68 articles (87%), the intervention can be categorized as monitoring. The largest proportion of telemedicine interventions consisted of measurements of vital signs combined with personal interaction between healthcare provider and patient (N=24), and concepts with only personal interaction (telephone or videoconferencing, N=14). The studies show predominantly positive results with a clear trend towards better results for "behavioral" endpoints, e.g. adherence to medication or diet, and self-efficacy compared to results for medical outcomes (e.g. blood pressure, or mortality), quality of life, and economic outcomes (e.g. costs or hospitalization). However, in 26 of 68 included studies, patients with characteristic limitations for older patients (e.g. cognitive and visual impairment, communication barriers, hearing problems) were excluded. A considerable number of projects use rather sophisticated technology (e.g. videoconferencing), limiting ready translation into routine care. Future research should focus on how to adapt systems to the individual needs and resources of elderly patients within the specific frameworks of the respective national healthcare systems.

Vegeasna, A., Tran, M., Angelaccio, M., et al. (2016). "Remote Patient Monitoring via Non-Invasive Digital Technologies: A Systematic Review." *Telemed J E Health*.

BACKGROUND: We conducted a systematic literature review to identify key trends associated with remote patient monitoring (RPM) via noninvasive digital technologies over the last decade. **MATERIALS AND METHODS:** A search was conducted in EMBASE and Ovid MEDLINE. Citations were screened for relevance against predefined selection criteria based on the PICOTS (Population, Intervention, Comparator, Outcomes, Timeframe, and Study Design) format. We included studies published between January 1, 2005 and September 15, 2015 that used RPM via noninvasive digital technology (smartphones/personal digital assistants [PDAs], wearables, biosensors, computerized systems, or multiple components of the formerly mentioned) in evaluating health outcomes compared to standard of care or another technology. Studies were quality appraised according to Critical Appraisal Skills Programme. **RESULTS:** Of 347 articles identified, 62 met the selection criteria. Most studies were randomized control trials with older adult populations, small sample sizes, and limited

follow-up. There was a trend toward multicomponent interventions ($n = 26$), followed by smartphones/PDAs ($n = 12$), wearables ($n = 11$), biosensor devices ($n = 7$), and computerized systems ($n = 6$). Another key trend was the monitoring of chronic conditions, including respiratory (23%), weight management (17%), metabolic (18%), and cardiovascular diseases (16%). Although substantial diversity in health-related outcomes was noted, studies predominantly reported positive findings. CONCLUSIONS: This review will help decision makers develop a better understanding of the current landscape of peer-reviewed literature, demonstrating the utility of noninvasive RPM in various patient populations. Future research is needed to determine the effectiveness of RPM via noninvasive digital technologies in delivering patient healthcare benefits and the feasibility of large-scale implementation.

Verberk, W. J., Kessels, A. G. et Thien, T. (2011). "Telecare is a valuable tool for hypertension management, a systematic review and meta-analysis." *Blood Press Monit* **16**(3): 149-155.

There is an increasing interest for using telecare(TC) in the management of hypertension. A systematic review to the use of blood pressure (BP) measurement in TC has been performed (Medline/PubMed, Embase, and Cochrane Library), selecting randomized clinical trials that compared TC with usual care (UC) for hypertension management (treatment and/or coaching). Nine randomized clinical trials were selected ($n=2501$, 61.4 ± 0.6 years, $42\pm 2.7\%$ males). Overall there was a significant larger decrease in the TC group than in the UC group for systolic (5.2 ± 1.5 mmHg; $P<0.001$) and diastolic BP (2.1 ± 0.8 mmHg; $P<0.01$). When studies were separated for antihypertensive treatment modification during the study (yes or no), systolic BP decrease difference between the TC and UC groups (DeltaTC-DeltaUC) tended to be significantly lower (5.1 ± 2.9 mmHg lower) with treatment modification compared with nontreatment modification in which the DeltaTC-DeltaUC was 8.6 ± 2.4 mmHg, $P=0.07$. TC led to a greater decrease in systolic and diastolic BP than UC. The differences between TC and UC for systolic BP tend to become larger when no treatment modification is applied. TC seems a valuable tool for hypertension management.

Wakefield, B. J., Turvey, C. L., Nazi, K. M., et al. (2017). "Psychometric Properties of Patient-Facing eHealth Evaluation Measures: Systematic Review and Analysis." *J Med Internet Res* **19**(10): e346.

BACKGROUND: Significant resources are being invested into eHealth technology to improve health care. Few resources have focused on evaluating the impact of use on patient outcomes. A standardized set of metrics used across health systems and research will enable aggregation of data to inform improved implementation, clinical practice, and ultimately health outcomes associated with use of patient-facing eHealth technologies. OBJECTIVE: The objective of this project was to conduct a systematic review to (1) identify existing instruments for eHealth research and implementation evaluation from the patient's point of view, (2) characterize measurement components, and (3) assess psychometrics. METHODS: Concepts from existing models and published studies of technology use and adoption were identified and used to inform a search strategy. Search terms were broadly categorized as platforms (eg, email), measurement (eg, survey), function/information use (eg, self-management), health care occupations (eg, nurse), and eHealth/telemedicine (eg, mHealth). A computerized database search was conducted through June 2014. Included articles (1) described development of an instrument, or (2) used an instrument that could be traced back to its original publication, or (3) modified an instrument, and (4) with full text in English language, and (5) focused on the patient perspective on technology, including patient preferences and satisfaction, engagement with technology, usability, competency and fluency with technology, computer literacy, and trust in and acceptance of technology. The review was limited to instruments that reported at least one psychometric property.

Excluded were investigator-developed measures, disease-specific assessments delivered via

technology or telephone (eg, a cancer-coping measure delivered via computer survey), and measures focused primarily on clinician use (eg, the electronic health record). RESULTS: The search strategy yielded 47,320 articles. Following elimination of duplicates and non-English language publications (n=14,550) and books (n=27), another 31,647 articles were excluded through review of titles. Following a review of the abstracts of the remaining 1096 articles, 68 were retained for full-text review. Of these, 16 described an instrument and six used an instrument; one instrument was drawn from the GEM database, resulting in 23 articles for inclusion. None included a complete psychometric evaluation. The most frequently assessed property was internal consistency (21/23, 91%). Testing for aspects of validity ranged from 48% (11/23) to 78% (18/23). Approximately half (13/23, 57%) reported how to score the instrument. Only six (26%) assessed the readability of the instrument for end users, although all the measures rely on self-report. CONCLUSIONS: Although most measures identified in this review were published after the year 2000, rapidly changing technology makes instrument development challenging. Platform-agnostic measures need to be developed that focus on concepts important for use of any type of eHealth innovation. At present, there are important gaps in the availability of psychometrically sound measures to evaluate eHealth technologies.

Walker, C. L., Kopp, M., Binford, R. M., et al. (2017). "Home Telehealth Interventions for Older Adults With Diabetes." Home Healthc Now **35**(4): 202-210.

The purpose of this literature review was to explore home telemedicine interventions for the treatment of older adults with diabetes. Eight databases were searched for articles published between 2011 and 2016, in the English language, and in peer-reviewed journals, resulting in 1,274 relevant articles. Following review against inclusion and exclusion criteria, six articles were retained. Studies included participants with a mean age from 68 to 76.8 years and from three different countries, with either Type 1 or Type 2 Diabetes Mellitus. The articles reviewed suggest that case management, education, closed-loop feedback and communication, home telemonitoring devices or units, and motivational interviewing or coaching can effectively decrease admissions, costs per person per year, mortality, and cognitive decline in older adults with diabetes. The scarcity of high-quality studies is consistent with findings from previous systematic reviews, and highlights the need for additional investigation before applying the results in practice.

Whitehead, L. et Seaton, P. (2016). "The Effectiveness of Self-Management Mobile Phone and Tablet Apps in Long-term Condition Management: A Systematic Review." J Med Internet Res **18**(5): e97.

BACKGROUND: Long-term conditions and their concomitant management place considerable pressure on patients, communities, and health care systems worldwide. International clinical guidelines on the majority of long-term conditions recommend the inclusion of self-management programs in routine management. Self-management programs have been associated with improved health outcomes; however, the successful and sustainable transfer of research programs into clinical practice has been inconsistent. Recent developments in mobile technology, such as mobile phone and tablet computer apps, could help in developing a platform for the delivery of self-management interventions that are adaptable, of low cost, and easily accessible. OBJECTIVE: We conducted a systematic review to assess the effectiveness of mobile phone and tablet apps in self-management of key symptoms of long-term conditions. METHODS: We searched PubMed, Embase, EBSCO databases, the Cochrane Library, and The Joanna Briggs Institute Library for randomized controlled trials that assessed the effectiveness of mobile phone and tablet apps in self-management of diabetes mellitus, cardiovascular disease, and chronic lung diseases from 2005-2016. We searched registers of current and ongoing trials, as well as the gray literature. We then

checked the reference lists of all primary studies and review papers for additional references. The last search was run in February 2016. RESULTS: Of the 9 papers we reviewed, 6 of the interventions demonstrated a statistically significant improvement in the primary measure of clinical outcome. Where the intervention comprised an app only, 3 studies demonstrated a statistically significant improvement. Interventions to address diabetes mellitus (5/9) were the most common, followed by chronic lung disease (3/9) and cardiovascular disease (1/9). A total of 3 studies included multiple intervention groups using permutations of an intervention involving an app. The duration of the intervention ranged from 6 weeks to 1 year, and final follow-up data ranged from 3 months to 1 year. Sample size ranged from 48 to 288 participants. CONCLUSIONS: The evidence indicates the potential of apps in improving symptom management through self-management interventions. The use of apps in mHealth has the potential to improve health outcomes among those living with chronic diseases through enhanced symptom control. Further innovation, optimization, and rigorous research around the potential of apps in mHealth technology will move the field toward the reality of improved health care delivery and outcomes.

Whiteman, K. L., Naslund, J. A., DiNapoli, E. A., et al. (2016). "Systematic Review of Integrated General Medical and Psychiatric Self-Management Interventions for Adults With Serious Mental Illness." *Psychiatr Serv*: appips201500521.

OBJECTIVE: Adults with serious mental illness are disproportionately affected by general medical comorbidity, earlier onset of disease, and premature mortality. Integrated self-management interventions have been developed to address both general medical and psychiatric illnesses. This systematic review examined evidence about the effect of self-management interventions that target both general medical and psychiatric illnesses and evaluated the potential for implementation. METHODS: Databases, including CINAHL, Cochrane Central, Ovid MEDLINE, PsycINFO, and Web of Science, were searched for articles published between 1946 and July 2015. Studies evaluating integrated general medical and psychiatric self-management interventions for adults with schizophrenia spectrum or mood disorders and general medical comorbidity were included. RESULTS: Fifteen studies (nine randomized controlled trials and six pre-post designs) reported on nine interventions: automated telehealth, Health and Recovery Peer program, Helping Older People Experience Success, Integrated Illness Management and Recovery, Life Goals Collaborative Care, Living Well, Norlunga Chronic Disease Self-Management program, Paxton House, and Targeted Training in Illness Management. Most studies demonstrated feasibility, acceptability, and preliminary effectiveness; however, clinical effectiveness could not be established in most studies because of methodological limitations. Factors identified that may deter implementation included operating costs, impractical length, and workforce requirements. CONCLUSIONS: Integrated general medical and psychiatric illness self-management interventions appear feasible and acceptable, with high potential for clinical effectiveness. However, implementation factors were rarely considered in intervention development, which may contribute to limited uptake and reach in real-world settings.

Woo, K. et Dowding, D. (2018). "Factors Affecting the Acceptance of Telehealth Services by Heart Failure Patients: An Integrative Review." *Telemed J E Health* **24**(4): 292-300.

BACKGROUND: While telehealth has been shown to improve heart failure patients' health outcomes, patients' acceptance of telehealth at the point of referral is reported to be low. Little is known about the factors related to patients' initial acceptance or refusal of telehealth services. The aim of this review was to synthesize evidence on the factors affecting heart failure patients' decision making to accept telehealth services in a home setting. METHODS: An integrative literature review was conducted. Six electronic databases and three grey

literature sites were searched. Two reviewers independently reviewed articles for inclusion. Articles were included if they reported original data related to the acceptance of telehealth services among heart failure patients at home. RESULTS: Five studies met the inclusion criteria and were included in the review. Key findings indicated that patients generally hold positive views about telehealth. Factors that may affect the adoption of telehealth include concerns over equipment or technology, concerns over service change, ease-of-use, knowledge of the benefits of telehealth, access to care, cost, and privacy. CONCLUSIONS: Despite evidence of effectiveness for telehealth, there is a high rate of telehealth refusal among patients. Understanding factors associated with heart failure patients' decisions regarding telehealth can help healthcare organizations structure education programs and other interventions to improve acceptance rates.

Wu, Y., Zhao, P., Li, W., et al. (2019). "The effect of remote health intervention based on internet or mobile communication network on hypertension patients: Protocol for a systematic review and meta-analysis of randomized controlled trials." *Medicine (Baltimore)* **98**(9): e14707.

BACKGROUND: To systematically review the impact of remote health interventions based on an internet or mobile communication network on patients with hypertension and to provide a theoretical basis for hypertension patients with the implementation of remote health interventions. METHODS: Data were retrieved from a total of 4 Chinese databases and 3 foreign databases. The Chinese databases included: China National Knowledge Infrastructure (CNKI), WanFang Data, Chinese Biomedical Database (SinoMed), and Chongqing Chinese Science and Technology Journey database (VIP). The foreign language databases included PubMed, The Cochrane Library, and Embase, and the date range for the search was from the date the database became active to December 1, 2018. After screening and extracting the materials and evaluating the risk of bias in each study (conducted by 2 researchers), the quality of the selected literature was evaluated by Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014, and the statistical analysis was applied by Stata 12.0 software. RESULT: This study will provide high-quality evidence-based medicine research evidence for remote health interventions on hypertensive patients based on the Internet and mobile communication network using systematic evaluation and meta-analysis methods. CONCLUSION: This systematic review will provide a scientific conclusion as to whether the remote health intervention model based on an internet or mobile communication network can better control blood pressure and improve patient compliance than the traditional nursing intervention model for hypertensive patients. ETHICS AND DISSEMINATION: This protocol for a systematic review and meta-analysis of randomized controlled trials does not require ethical approval and the results of this paper will be published in an open form in internationally influential academic journals. PROTOCOL AND REGISTRATION: A protocol had been registered in PROSPERO CRD42019122404.

Yang, F., Xiong, Z. F., Yang, C., et al. (2017). "Continuity of Care to Prevent Readmissions for Patients with Chronic Obstructive Pulmonary Disease: A Systematic Review and Meta-Analysis." *Copd* **14**(2): 251-261.

Readmissions of patients with chronic obstructive pulmonary disease (COPD) to hospitals cast a heavy burden to health care systems. This meta-analysis was aimed to assess the efficacy of continuity of care as interventions, which reduced readmission and mortality rates of such patients. PubMed, Cochrane Library and Embase were searched for articles published before July 2015. A total of 31 reports with randomized controlled trials (RCTs) were finally included in this meta-analysis. The results showed that health education reduced all-cause readmission at 3 months. In addition, health education, comprehensive nursing intervention

(CNI) and telemonitoring reduced all-cause readmissions over 6-12 months, and the effect of CNI was best because CNI also reduced COPD-specific readmissions. Home visits also reduced COPD-specific readmissions (the quality more than moderate), but it did not reduce the risk for all-cause readmissions (risk ratios (RRs), 0.92 [95% CI, 0.82-1.04]; moderate quality). There was no statistically significant difference in reducing mortality and quality of life (QOL) among various continued cares. In conclusion, CNI, telemonitoring, health education and home visits should receive more consideration than other interventions by caregivers seeking to implement continued care interventions for patients with COPD.

Yasmin, F., Banu, B., Zakir, S. M., et al. (2016). "Positive influence of short message service and voice call interventions on adherence and health outcomes in case of chronic disease care: a systematic review." *BMC Med Inform Decis Mak* **16**: 46.

BACKGROUND: Chronic diseases have emerged as a serious threat for health, as well as for global development. They endanger considerably increased health care costs and diminish the productivity of the adult population group and, therefore, create a burden on health, as well as on the global economy. As the management of chronic diseases involves long-term care, often lifelong patient adherence is the key for better health outcomes. We carried out a systematic literature review on the impact of mobile health interventions -mobile phone texts and/or voice messages- in high, middle and low income countries to ascertain the impact on patients' adherence to medical advice, as well as the impact on health outcomes in cases of chronic diseases. **METHODS:** The review identified fourteen related studies following the defined inclusion and exclusion criteria, in PubMed, Cochrane Library, the Library of Congress, and Web Sciences. All the interventions were critically analysed according to the study design, sample size, duration, tools used, and the statistical methods used for analysing the primary data. Impacts of the different interventions on outcomes of interest were also analysed. **RESULTS:** The findings showed evidence of improved adherence, as well as health outcomes in disease management, using mobile Short Message Systems and/or Voice Calls. Significant improvement has been found on adherence with taking medicine, following diet and physical activity advice, as well as improvement in clinical parameters like HbA1c, blood glucose, blood cholesterol and control of blood pressure and asthma. **CONCLUSIONS:** Though studies showed positive impacts on adherence and health outcomes, three caveats should be considered, (i) there was no clear understanding of the processes through which interventions worked; (ii) none of the studies showed cost data for the m-health interventions and (iii) only short term impacts were captured, it remains unclear whether the effects are sustained. More research is needed in these three areas before drawing concrete conclusions and making suggestions to policy makers for further decision and implementation.

Yun, J. E., Park, J. E., Park, H. Y., et al. (2018). "Comparative Effectiveness of Telemonitoring Versus Usual Care for Heart Failure: A Systematic Review and Meta-analysis." *J Card Fail* **24**(1): 19-28.

BACKGROUND: This study aimed to evaluate the effectiveness of telemonitoring (TM) in the management of patients with heart failure (HF). **METHODS AND RESULTS:** We searched Ovid-Medline, Ovid-Embase, and the Cochrane Library for randomized controlled trials published through May 2016. Outcomes of interest included clinical effectiveness (mortality, hospitalization, and emergency department visits) and patient-reported outcomes. TM was defined as the transmission of individual biologic data, such as weight, blood pressure, and heart rate. Thirty-seven randomized controlled trials (9582 patients) of TM met the inclusion criteria: 24 studies on all-cause mortality, 17 studies on all-cause hospitalization, 12 studies on HF-related hospitalization, and 5 studies on HF-related mortality. The risks of all-cause mortality (risk ratio [RR] 0.81, 95% confidence interval [CI] 0.70-0.94) and HF-related

mortality (RR 0.68, 95% CI 0.50-0.91) were significantly lower in the TM group than in the usual care group. TM showed a significant benefit when ≥ 3 biologic data are transmitted or when transmission occurred daily. TM also reduced mortality risk in studies that monitored patients' symptoms, medication adherence, or prescription changes. CONCLUSIONS: TM intervention reduces the mortality risk in patients with HF, and intensive monitoring with more frequent transmissions of patient data increases its effectiveness.

Zhou, M., Holden, L., Bedard, G., et al. (2012). "The utilization of telephone follow-up in the advanced cancer population: a review of the literature." *J Comp Eff Res* **1**(6): 509-517.

BACKGROUND: Palliative cancer patients often require clinic or hospital follow-up after any treatment intervention they may have received. This is typically done in person at either a hospital or a clinic. In these advanced cancer patients, this may be burdensome and result in attrition. Telephone follow-up is becoming more frequently used as an adjunct to clinical follow-up. It can be conducted for both clinical trials, as well as interventional purposes. The purpose of this study was to review the literature and examine the utility and effectiveness of telephone follow-up in the advanced cancer population. **METHODS:** A literature search was conducted on Medline (1980 - April week 4 2012), Embase (1980 - week 17 2012), the Cochrane Central Register of Controlled Trials (April 2012) and CINAHL (1981-July 31 2012). **RESULTS:** A total of 11 studies were identified that were published between 2001 and 2011. All studies were in the clinical trial setting. Studies that utilized telephone follow-up in the advanced cancer population, as well as studies that compared the feasibility of telephone follow-up with hospital follow-up, were included in this review. Follow-up at week 4 (month 1) was the most common interval for patient contact. Information collected during the contact varied with the study; however, the most commonly used tool was the Edmonton Symptom Assessment System. Other information included analgesic diary, patient feedback, satisfaction with the care and post-treatment side effects, along with a variety of quality of life questionnaires. Some studies provided information to the patient about protocols for care, advice and coping strategies. Attrition was common even with the use of telephone contact in place of clinical follow-up. **CONCLUSION:** Telephone follow-up is a feasible alternative to traditional hospital follow-ups for assessment of symptom palliation. There are fewer burdens on the patient, allowing for a better maintenance of quality of life and lower rates of attrition in clinical trials. Patients had an overall positive opinion of the use of this alternative approach with no common disadvantages. A combination of follow-up strategies, such as clinic follow-up and telephone contact for those not attending, may result in a more comprehensive assessment.

LES ETUDES FRANÇAISES

Boudy, J. (2007). "Recherche et développement. Technologies de l'information, handicap et gérontologie." *Revue Hospitaliere De France*(515): 54-59, graph.

[BDSP. Notice produite par ENSP 5R0xpraW. Diffusion soumise à autorisation]. Face au double défi du vieillissement de la population et de la montée en charge des dépenses de santé, l'emploi des technologies de l'information et de la communication ouvre un champ d'applications nouvelles dans l'assistance et le suivi de personnes malades, dépendantes, handicapées ou à mobilité réduite. Le Groupe des écoles des télécommunications (GET) a développé une très forte compétence en systèmes électroniques, réseaux, traitement de signal et d'images et en sociologie des TIC. Plusieurs projets de recherche sont pilotés par ses laboratoires dans les domaines de l'assistance : télémédecine et télésurveillance médicale, assistance au handicap, maintien du lien social. Le développement de ces systèmes exige un partenariat étroit entre les équipes médicales (INSERM, hôpitaux, CHU...), les laboratoires et

les industriels. Il soulève, outre les problèmes techniques, des questions d'acceptabilité, de confidentialité, de modèles économiques et de régulation. Ses chercheurs présentent à titre d'exemple, l'application des TIC à la télévigilance (ou télésurveillance médicale).

Caillette-Beaudoin, A., Grangier, J.-P., Huguet, G., et al. (2014). "La télésurveillance en dialyse péritonéale." Gestions Hospitalieres(534): 141-142.

[BDSP. Notice produite par EHESP R0xpBD8k. Diffusion soumise à autorisation]. Caly dial, établissement de santé lyonnais, s'est lancé dans le développement d'un programme de télémédecine sur tous ses domaines d'activité autorisés : dialyse péritonéale, hémodialyse et insuffisance rénale chronique non dialysée. Convaincu que la coconstruction joue un rôle majeur dans la création de solutions innovantes, Caly dial participe à un "living lab" pour le développement de la télésurveillance en dialyse péritonéale.

Caillette-Beaudoin, A., Grangier, J.-P., Kuentz, F., et al. (2010). "Maladies chroniques cardiovasculaires et métaboliques : apports de la télémédecine." Revue Hospitaliere De France(532): 29-31, graph.

[BDSP. Notice produite par EHESP R0xBD888. Diffusion soumise à autorisation]. La télésurveillance des maladies chroniques montre sa capacité à optimiser la qualité et la sécurité des soins dans de nombreuses pathologies. Illustration avec une expérience menée en Rhône-Alpes auprès de patients insuffisants rénaux chroniques.

Goin, A. L., Dahan, M., Murrin, M., et al. (2015). "[Home telemonitoring of lung-transplanted patients: A feasibility study]." Rev Mal Respir **32**(5): 546-549.

Guedon-Moreau, L., Lerouge, V., Veirman, E., et al. (2017). "[Telemonitoring by the nurse of patients equipped with an implantable heart device]." Soins **62**(820): 48-49.

The nurse is at the heart of the caregiving relationship in the remote monitoring of patients with heart failure equipped with an implantable device. Her direct contact with the patient erases the distance imposed by telemonitoring and her close connection with the cardiologist-arrhythmia specialist ensures the patient follow-up is optimal. After her training in telemedicine, the nurse plays a key role in the telerhythmology activity.

Karout, P. (2005). "Service vigilance : solution de veille préventive à distance pour l'accompagnement à domicile de personnes en perte d'autonomie." Gerontologie Et Societe(113): 25-35, fig.

[BDSP. Notice produite par FNG vSovR0x4. Diffusion soumise à autorisation]. Vivre son grand âge à domicile est un enjeu actuel : 98% des plus de 75 ans souhaiteraient pouvoir continuer à vivre chez eux le plus longtemps possible même lorsqu'ils sont seuls. Face à cette situation, l'entreprise Vicineo a travaillé avec plusieurs équipes de professionnels de l'accompagnement à domicile pour envisager grâce aux "technologies Internet" un nouveau service de veille à distance complémentaire des interventions à domicile et plus riche que la traditionnelle télé-alarme : le "Service Vigilance".

Maillard, N., Perrotton, F., Delage, E., et al. (2014). "Cardiac remote monitoring in France." Arch Cardiovasc Dis **107**(4): 253-260.

The increase in number of implanted cardiac medical devices and the announced decrease in number of cardiologists have led to remote monitoring being considered as a pivotal tool for patient follow-up. For 10 years, remote monitoring has been the subject of multiple clinical

studies. In these studies, reliability and clinical efficacy have been demonstrated, but the use of remote monitoring remains quite limited in France compared with other countries. To explain this delay in uptake, some organizational difficulties and the lack of reimbursement of remote monitoring are often mentioned. The results of medico-economic studies might provide answers about the value of remote monitoring and enable the supervisory authorities to define how its use will be financed. This review provides a global view of remote monitoring in France, and covers the principle, clinical efficacy, organizational and regulatory aspects, and medico-economic data.

Morichau-Beauchant, T., Boule, S., Guedon-Moreau, L., et al. (2014). "Remote monitoring of patients with implantable cardioverter-defibrillators: can results from large clinical trials be transposed to clinical practice?" *Arch Cardiovasc Dis* **107**(12): 664-671.

BACKGROUND: Remote monitoring (RM) is increasingly used to follow up patients with implantable cardioverter-defibrillators (ICDs). Randomized control trials provide evidence for the benefit of this intervention, but data for RM in daily clinical practice with multiple-brands and unselected patients is lacking. **AIMS:** To assess the effect of RM on patient management and clinical outcome for recipients of ICDs in daily practice. **METHODS:** We reviewed ICD recipients followed up at our institution in 2009 with RM or with traditional hospital only (HO) follow-up. We looked at the effect of RM on the number of scheduled ambulatory follow-ups and urgent unscheduled consultations, the time between onset of asymptomatic events to clinical intervention and the clinical effectiveness of all consultations. We also evaluated the proportion of RM notifications representing clinically relevant situations. **RESULTS:** We included 355 patients retrospectively (RM: n=144, HO: n=211, 76.9% male, 60.3+/-15.2 years old, 50.1% with ICDs for primary prevention and mean left ventricular ejection fraction 35.5+/-14.5%). Average follow-up was 13.5 months. The RM group required less scheduled ambulatory follow-up consultations (1.8 vs. 2.1/patient/year; P<0.0001) and a far lower median time between the onset of asymptomatic events and clinical intervention (7 vs. 76 days; P=0.016). Of the 784 scheduled ambulatory follow-up consultations carried out, only 152 (19.4%) resulted in therapeutic intervention or ICD reprogramming. We also found that the vast majority of RM notifications (61.9%) were of no clinical relevance. **CONCLUSION:** RM allows early management of asymptomatic events and a reduction in scheduled ambulatory follow-up consultations in daily clinical practice, without compromising safety, endorsing RM as the new standard of care for ICD recipients.

Noury, N. r. (2005). "AILISA : plateformes d'évaluations pour des technologies de télésurveillance médicale et d'assistance en gérontologie." *Gerontologie Et Societe*(113): 89-96, fig.

[BDSP. Notice produite par FNG 1R0xqRxz. Diffusion soumise à autorisation]. Le projet AILISA a pour objectif de mettre en place des plateformes pérennes pour l'évaluation de technologies de télésurveillance médicale et d'assistance en gérontologie. Les plateformes seront installées dans deux services gériatriques : l'un à l'hôpital Charles Foix (Ivry-sur-Seine) et l'autre au CHU La Grave (Toulouse), et dans deux appartements d'un foyer logement pour personnes âgées (Grenoble). Les sites d'évaluation disposeront de trois technologies mises au point dans les laboratoires de la recherche publique française : l'Habitat Intelligent pour la Santé (TIISAD), le vêtement de Télé-Assistance Médicale Nomade (VTAMN) et le robot déambulateur (MONIMAD). Il s'agit ici d'évaluer ces technologies sur les plans technologique, médical et aussi sur le plan de l'usage et de l'éthique.

Pelletier-Fleury, N. et Lanoe, J. L. (2001). "Equivalence versus pragmatic trials for the economic evaluation of information and communication technologies; the case of polysomnography under telesurveillance in the diagnosis of sleep apnea syndrome." *Health Policy* **57**(3): 225-234.

This article deals with the choice of the appropriate protocols for the early economic evaluation of information and communication technologies, equivalence trial versus pragmatic trial. The reasoning put forward here is based on a concrete interrogation relative to polysomnography (PSG), a key diagnostic test for sleep apnoea syndrome (SAS). Is PSG under tele-surveillance more efficient than ambulatory PSG to diagnose SAS? After analyzing and discussing both advantages and limits of these two kinds of trial, we showed that one or the other can be used to obtain appropriate results. But in this particular example, we concluded that a pragmatic trial should be preferred, knowing that it requires a smaller sample of patients along with a narrower range of uncertainty concerning the evaluation of costs.

Schaefer, E., Schnell, G. et Sonsalla, J. (2015). "Obtaining reimbursement in France and Italy for new diabetes products." *J Diabetes Sci Technol* **9**(1): 156-161.

Manufacturers launching next-generation or innovative medical devices in Europe face a very heterogeneous reimbursement landscape, with each country having its own pathways, timing, requirements and success factors. We selected 2 markets for a deeper look into the reimbursement landscape: France, representing a country with central decision making with defined processes, and Italy, which delegates reimbursement decisions to the regional level, resulting in a less transparent approach to reimbursement. Based on our experience in working on various new product launches and analyzing recent reimbursement decisions, we found that payers in both countries do not reward improved next-generation products with incremental reimbursement. Looking at innovations, we observe that manufacturers face a challenging and lengthy process to obtain reimbursement. In addition, requirements and key success factors differ by country: In France, comparative clinical evidence and budget impact very much drive reimbursement decisions in terms of pricing and restrictions, whereas in Italy, regional key opinion leader (KOL) support and additional local observational data are key.

Snitem (2016). Etude NOEMIE. Nouveaux modèles économiques de eSanté en Europe. Courbevoie Snitem: 58 , tabl., fig.

Ce rapport présente une étude sur les modèles économiques de e-santé en Europe et sur leur "transposabilité" pour trouver en France un modèle financé pérenne. Elle repose sur une analyse empirique de quatre projets mis en place en Angleterre, en Allemagne, en Italie et en Espagne, pays choisis pour leurs systèmes proches du système de santé français car reposant sur un modèle de prise en charge publique et universelle.

Thilly, N., Chanliau, J., Frimat, L., et al. (2017). "Cost-effectiveness of home telemonitoring in chronic kidney disease patients at different stages by a pragmatic randomized controlled trial (eNephro): rationale and study design." *BMC Nephrol* **18**(1): 126.

BACKGROUND: Home telemonitoring has developed considerably over recent years in chronic diseases in order to improve communication between healthcare professionals and patients and to promote early detection of deteriorating health status. In the nephrology setting, home telemonitoring has been evaluated in home dialysis patients but data are scarce concerning chronic kidney disease (CKD) patients before and after renal replacement therapy. The eNephro study is designed to assess the cost effectiveness, clinical/biological impact, and patient perception of a home telemonitoring for CKD patients. Our purpose is to present the rationale, design and organisational aspects of this study. **METHODS:** eNephro is a pragmatic randomised controlled trial, comparing home telemonitoring versus usual care in

three populations of CKD patients: stage 3B/4 (n = 320); stage 5D CKD on dialysis (n = 260); stage 5 T CKD treated with transplantation (n= 260). Five hospitals and three not-for-profit providers managing self-care dialysis situated in three administrative regions in France are participating. The trial began in December 2015, with a scheduled 12-month inclusion period and 12 months follow-up. Outcomes include clinical and biological data (e.g. blood pressure, haemoglobin) collected from patient records, perceived health status (e.g. health related quality of life) collected from self-administered questionnaires, and health expenditure data retrieved from the French health insurance database (SNIIRAM) using a probabilistic matching procedure. DISCUSSION: The hypothesis is that home telemonitoring enables better control of clinical and biological parameters as well as improved perceived health status. This better control should limit emergency consultations and hospitalisations leading to decreased healthcare expenditure, compensating for the financial investment due to the telemedicine system. TRIAL REGISTRATION: This study has been registered at ClinicalTrials.gov under NCT02082093 (date of registration: February 14, 2014).

La télésurveillance pour insuffisance cardiaque

LES ETUDES D'ÉVALUATION ÉCONOMIQUE : LES REVUES DE LITTÉRATURE

Étude d'évaluation médico-économique française

Le suivi à distance peut améliorer la gestion de l'insuffisance cardiaque, mais il n'existe pas de cadre d'évaluation normalisé pour en évaluer l'impact de manière exhaustive. Les objectifs de l'étude de Farnia⁴ parue en 2015 étaient de répertorier les critères utilisés dans les évaluations publiées de projets de télémonitorage non invasifs en ondes décimétriques, de décrire leur utilisation dans les études d'évaluation et de les organiser de manière cohérente. Les articles publiés de janvier 1990 à août 2015 ont été recensés via les bases de données Medline, Web of Science et Embase. Les articles étaient éligibles s'il s'agissait de rapports originaux d'une étude d'évaluation non invasive en télésurveillance en ondes décimétriques en anglais. Les études sur les dispositifs de télémonitorage implantables ont été exclues. Chaque article a été sélectionné pour extraire la description du projet de télémonitoring ainsi que le processus et les critères d'évaluation. Une synthèse qualitative a été réalisée. Cette étude identifie et examine 128 articles conduisant à 52 critères d'évaluation classés en 6 dimensions: clinique, économique, perspective de l'utilisateur, pédagogique, organisationnelle et technique. Les impacts cliniques et économiques ont été évalués dans plus de 70 % des études, tandis que les impacts éducatifs, organisationnels et techniques ont été étudiés dans moins de 15 %. La perspective des utilisateurs était la dimension la plus fréquemment prise en compte dans la phase de développement des projets de télésurveillance, tandis que les impacts cliniques et économiques étaient au centre des phases ultérieures. La conclusion de l'étude était la suivante : les cadres d'évaluation du télémonitoring doivent couvrir l'ensemble des 6 dimensions correctement réparties tout au long du cycle de vie du projet de télémonitoring. Une prochaine étude aura pour objectif de créer un tel cadre complet d'évaluation pour le télémonitoring et de le tester sur un projet de télémonitorage HF non invasif en cours.

Agostini, M., Moja, L., Banzi, R., et al. (2015). "Telerehabilitation and recovery of motor function: a systematic review and meta-analysis." *J Telemed Telecare* **21**(4): 202-213.

Recent advances in telecommunication technologies have boosted the possibility to deliver rehabilitation via the internet (i.e. telerehabilitation). Several studies have shown that telerehabilitation is effective to improve clinical outcomes in disabling conditions. The aim of this review was to determine whether telerehabilitation was more effective than other modes of delivering rehabilitation to regain motor function, in different populations of patients. We searched PubMed, Embase and the Cochrane library retrieving 2360 records. Twelve studies were included involving different populations (i.e. neurological, total knee arthroplasty (TKA), cardiac) of patients. Inconclusive findings were found on the effect of telerehabilitation for neurological patients (SMD = 0.08, CI 95% = -0.13, 0.29), while both for cardiac (SMD = 0.24, CI 95% = 0.04, 0.43) and TKA patients (Timed Up and Go test: MD = -5.17, CI 95% = -9.79, -0.55) the results were in favour of telerehabilitation. Conclusive evidence on the efficacy of telerehabilitation for treatment of motor function, regardless of pathology, was not reached. Nevertheless, a strong positive effect was found for patients following orthopaedic surgery, suggesting that the increased intensity provided by telerehabilitation is a promising option to be offered to patients. More and higher quality research is needed in this field especially with neurological patients.

Augustin, U. et Henschke, C. (2012). "[Does telemonitoring lead to health and economic benefits in patients with chronic heart failure? - a systematic review]." *Gesundheitswesen* **74**(12): e114-121.

Chronic heart failure is a severe and common disease combined with high costs for the German health care system. Deficiencies in standard therapy and limited financial capacities

⁴Farnia, T., M. C. Jaulent and O. Steichen (2018). "Evaluation Criteria of Noninvasive Telemonitoring for Patients With Heart Failure: Systematic Review." *J Med Internet Res* **20**(1): e16.

of the German health care system necessitate new approaches in the care of chronic heart failure patients. The present study aims to analyse the scientific level of knowledge of clinical, economic and other outcomes of telemonitoring compared with standard therapy for patients with chronic heart failure. Results should provide an evidence base for health-care decision makers. To determine the outcomes, a systematic review was carried out by using the database MEDLINE. In accordance with defined inclusion and exclusion criteria, 10 randomized controlled trials remained. Furthermore, 4 studies of a hand research and the recently published results of one of the largest national studies were included. As a result of the systematic review, there is currently no evidence for the benefits of telemonitoring compared with standard therapy. National studies identified significant improvements or a tendency for improvements in terms of quality of life and costs/cost-effectiveness as well as partly in mortality, hospital duration and medication adherence. International studies diverged in their results. The comparability and validity of the investigated studies are limited due to a low number of national studies, different settings of the telemonitoring programmes, the inclusion of different NYHA classes, the heterogeneity of study endpoints and endpoint-related causes, short observation periods of some studies as well as questionable transferability of international cost-results to the German health care system. Furthermore, differences in standard therapy between national and international studies were identified. None of the international studies performed a comparison between clinical and economic outcomes. With regard to the future prospects of telemonitoring in Germany there is still a need for further high quality studies (particularly on the national level) concerning the clinical, economic and other outcomes of telemonitoring compared with standard therapy. Clear evidence is a sine qua non for telemonitoring's inclusion in the benefits catalogue of the statutory health insurance. For a better comparability of studies, standardised telemonitoring programmes and study criteria should be developed and applied.

Carbo, A., Gupta, M., Tamariz, L., et al. (2018). "Mobile Technologies for Managing Heart Failure: A Systematic Review and Meta-analysis." Telemed J E Health.

BACKGROUND: Randomized clinical trials (RCTs) conducted among heart failure (HF) patients have reported that mobile technologies can improve HF-related outcomes. Our aim was to conduct a meta-analysis to evaluate m-Health's impact on healthcare services utilization, mortality, and cost. **METHODS:** We searched MEDLINE, Cochrane, CINAHL, and EMBASE for studies published between 1966 and May-2017. We included studies that compared the use of m-Health in HF patients to usual care. m-Health is defined as the use of mobile computing and communication technologies to record and transmit data. The outcomes were HF-related and all-cause hospital days, cost, admissions, and mortality. **RESULTS:** Our search strategy resulted in 1,494 articles. We included 10 RCTs and 1 quasi-experimental study, which represented 3,109 patients in North America and Europe. Patient average age range was 53-80 years, New York Heart Association (NYHA) class III, and Left Ventricular Ejection Fraction <50%. Patients were mostly monitored daily and followed for an average of 6 months. A reduction was seen in HF-related hospital days. Nonsignificant reductions were seen in HF-related cost, admissions, and mortality and total mortality. We found no significant differences for all-cause hospital days and admissions, and an increase in total cost. **CONCLUSIONS:** m-Health reduced HF-related hospital days, showed reduction trends in total mortality and HF-related admissions, mortality and cost, and increased total costs related to more clinic visits and implementation of new technologies. More studies reporting consistent quality outcomes are warranted to give conclusive information about the effectiveness and cost-effectiveness of m-Health interventions for HF.

Grustam, A. S., Severens, J. L., van Nijnatten, J., et al. (2014). "Cost-effectiveness of telehealth interventions for chronic heart failure patients: a literature review." Int J Technol Assess Health Care **30**(1): 59-68.

OBJECTIVES: Evidence exists that telehealth interventions (e.g., telemonitoring, teliagnostics, telephone care) in disease management for chronic heart failure patients can improve medical outcomes, and we aim to give an overview of the cost-effectiveness of these interventions. **METHODS:** Based on the literature search on "heart failure" in combination with "cost" and "telehealth" we selected 301 titles and abstracts. Titles and abstracts were screened for a set of inclusion criteria: telehealth intervention, heart failure as the main disease, economic analysis present and a primary study performed. In the end, thirty-two studies were included for full reading, data extraction, and critical appraisal of the economic evaluation. **RESULTS:** Most studies did not present a comprehensive economic evaluation, consisting of the comparison of both costs and effects between telehealth intervention and a comparator. Data on telehealth investment costs were lacking in many studies. The few studies that assessed costs and consequences comprehensively showed that telehealth interventions are cost saving with slight improvement in effectiveness, or comparably effective with similar cost to usual care. However, the methodological quality of the studies was in general considered to be low. **CONCLUSIONS:** The cost-effectiveness of telehealth in chronic heart failure is hardly ascertained in peer reviewed literature, the quality of evidence is poor and there was a difficulty in capturing all of the consequences/effects of telehealth intervention. We believe that without full economic analyses the cost-effectiveness of telehealth interventions in chronic heart failure remains unknown.

Hameed, A. S., Sauermann, S. et Schreier, G. (2014). "The impact of adherence on costs and effectiveness of telemedical patient management in heart failure: a systematic review." Appl Clin Inform **5**(3): 612-620.

OBJECTIVE: This paper analyzes evidence of the impact of patients' adherence to pharmacological and non-pharmacological recommendations on the treatment costs of heart failure (HF) patients. **METHODS:** A systematic review was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Papers were searched using various combinations of the following keywords: 'telemedicine', 'telemonitoring', 'telehealth', 'eHealth', 'remote monitoring', 'adherence', 'compliance', 'cost-effectiveness', 'cost-benefit', 'heart failure', 'healthcare costs', 'hospitalization', and 'drug costs'. We included only papers written in English or German, published between 1998 and 2014, and having one of our search terms in the title. **RESULTS:** Initially, 73 papers were selected. After a detailed review, these were narrowed down to 9 that reported an association between adherence and/or compliance and costs. However, none established a quantitative relationship between adherence and total healthcare costs. **CONCLUSION:** A model-based cost-effectiveness analysis that appropriately considers adherence has not been carried out so far, but is needed to fully understand the potential economic benefits of telehealth.

Heikkila, A. et Maijala, V. (2016). "Heart failure patients' experiences of mobile phone-based telemonitoring in self-care: a qualitative systematic review protocol." JBIC Database System Rev Implement Rep **14**(5): 68-74.

REVIEW QUESTION/OBJECTIVE: The objective of this systematic review is to explore heart failure patients' experiences of mobile-phone based telemonitoring in self-care.

Kotb, A., Cameron, C., Hsieh, S., et al. (2015). "Comparative effectiveness of different forms of telemedicine for individuals with heart failure (HF): a systematic review and network meta-analysis." *PLoS One* **10**(2): e0118681.

BACKGROUND: Previous studies on telemedicine have either focused on its role in the management of chronic diseases in general or examined its effectiveness in comparison to standard post-discharge care. Little has been done to determine the comparative impact of different telemedicine options for a specific population such as individuals with heart failure (HF). **METHODS AND FINDINGS:** Systematic reviews (SR) of randomized controlled trials (RCTs) that examined telephone support, telemonitoring, video monitoring or electrocardiographic monitoring for HF patients were identified using a comprehensive search of the following databases: MEDLINE, EMBASE, CINAHL and The Cochrane Library. Studies were included if they reported the primary outcome of mortality or any of the following secondary outcomes: all-cause hospitalization and heart failure hospitalization. Thirty RCTs (N = 10,193 patients) were included. Compared to usual care, structured telephone support was found to reduce the odds of mortality (Odds Ratio 0.80; 95% Credible Intervals [0.66 to 0.96]) and hospitalizations due to heart failure (0.69; [0.56 to 0.85]). Telemonitoring was also found to reduce the odds of mortality (0.53; [0.36 to 0.80]) and reduce hospitalizations related to heart failure (0.64; [0.39 to 0.95]) compared to usual post-discharge care. Interventions that involved ECG monitoring also reduced the odds of hospitalization due to heart failure (0.71; [0.52 to 0.98]). **LIMITATIONS:** Much of the evidence currently available has focused on the comparing either telephone support or telemonitoring with usual care. This has therefore limited our current understanding of how some of the less common forms of telemedicine compare to one another. **CONCLUSIONS:** Compared to usual care, structured telephone support and telemonitoring significantly reduced the odds of deaths and hospitalization due to heart failure. Despite being the most widely studied forms of telemedicine, little has been done to directly compare these two interventions against one another. Further research into their comparative cost-effectiveness is also warranted.

Michaud, T. L., Zhou, J., McCarthy, M. A., et al. (2018). "COSTS OF HOME-BASED TELEMEDICINE PROGRAMS: A SYSTEMATIC REVIEW." *Int J Technol Assess Health Care* **34**(4): 410-418.

OBJECTIVES: The aim of this study was to systematically investigate existing literature on the costs of home-based telemedicine programs, and to further summarize how the costs of these telemedicine programs vary by equipment and services provided. **METHODS:** We undertook a systematic review of related literature by searching electronic bibliographic databases and identifying studies published from January 1, 2000, to November 30, 2017. The search was restricted to studies published in English, results from adult patients, and evaluation of home telemedicine programs implemented in the United States. Summarized telemedicine costs per unit of outcome measures were reported. **RESULTS:** Twelve studies were eligible for our review. The overall annual cost of providing home-based telemedicine varied substantially depending on specific chronic conditions, ranging from USD1,352 for heart failure to USD206,718 for congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes as a whole. The estimated cost per-patient-visit ranged from USD24 for cancer to USD39 for CHF, COPD, or chronic wound care. **CONCLUSIONS:** The costs of home-based telemedicine programs varied substantially by program components, disease type, equipment used, and services provided. All the selected studies indicated that home telemedicine programs reduced care costs, although detailed cost data were either incomplete or not presented in detail. A comprehensive analysis of the cost of home-based telemedicine programs and their determinants is still required before the cost efficiency of these programs can be better understood, which becomes crucial for these programs to be more widely adopted and reimbursed.

Pandor, A., Gomersall, T., Stevens, J. W., et al. (2013). "Remote monitoring after recent hospital discharge in patients with heart failure: a systematic review and network meta-analysis." *Heart* **99**(23): 1717-1726.

CONTEXT: Readmission to hospital for heart failure is common after recent discharge. Remote monitoring (RM) strategies have the potential to deliver specialised care and management and may be one way to meet the growing needs of the heart failure population. OBJECTIVE: To determine whether RM strategies improve outcomes for adults who have been recently discharged (<28 days) following an unplanned admission due to heart failure. STUDY DESIGN: Systematic review and network meta-analysis. DATA SOURCES: Fourteen electronic databases (including MEDLINE, EMBASE and PsycINFO) were searched to January 2012, and supplemented by hand-searching relevant articles. STUDY SELECTION: All randomised-controlled trials (RCTs) or observational cohort studies with a contemporaneous control group were included. RM interventions included home telemonitoring (TM) (including implanted monitoring devices) with medical support provided during office hours or 24/7 and structured telephone support (STS) programmes delivered via human-to-human contact (HH) or human-to-machine interface (HM). DATA EXTRACTION: Data were extracted and validity was assessed independently by two reviewers. RESULTS: Twenty-one RCTs that enrolled 6317 patients were identified (11 studies evaluated STS (10 of which were HH, while 1 was HM), 9 studies assessed TM, and 1 study assessed both STS and TM). No trial of implanted monitoring devices met the inclusion criteria. Compared with usual care, although not reaching statistical significance, RM trended to reduce all-cause mortality for STS HH (HR: 0.77, 95% credible interval (CrI): 0.55, 1.08), TM during office hours (HR: 0.76, 95% CrI: 0.49, 1.18) and TM24/7 (HR: 0.49, 95% CrI: 0.20, 1.18). Exclusion of one trial that provided better-than-usual support to the control group rendered each of the above comparisons statistically significant. No beneficial effect on mortality was observed with STS HM. Reductions were also observed in all-cause hospitalisations for TM interventions but not for STS interventions. Care packages generally improved health-related quality-of-life and were acceptable to patients. CONCLUSIONS: STS HH and TM with medical support provided during office hours showed beneficial trends, particularly in reducing all-cause mortality for recently discharged patients with heart failure. Where 'usual' care is less good, the impact of RM is likely to be greater.

Pandor, A., Thokala, P., Gomersall, T., et al. (2013). "Home telemonitoring or structured telephone support programmes after recent discharge in patients with heart failure: systematic review and economic evaluation." *Health Technol Assess* **17**(32): 1-207, v-vi.

BACKGROUND: Remote monitoring (RM) strategies have the potential to deliver specialised care and management to patients with heart failure (HF). OBJECTIVE: To determine the clinical effectiveness and cost-effectiveness of home telemonitoring (TM) or structured telephone support (STS) strategies compared with usual care for adult patients who have been recently discharged (within 28 days) from acute care after a recent exacerbation of HF. DATA SOURCES: Fourteen electronic databases (including MEDLINE, EMBASE, PsycINFO and The Cochrane Library) and research registers were searched to January 2012, supplemented by hand-searching relevant articles and contact with experts. The review included randomised controlled trials (RCTs) or observational cohort studies with a contemporaneous control group that included the following RM interventions: (1) TM (including cardiovascular implanted monitoring devices) with medical support provided during office hours or 24/7; (2) STS programmes delivered by human-to-human contact (HH) or human-to-machine interface (HM). REVIEW METHODS: A systematic review and network meta-analysis (where appropriate) of the clinical evidence was carried out using standard methods. A Markov

model was developed to evaluate the cost-effectiveness of different RM packages compared with usual care for recently discharged HF patients. TM 24/7 or using cardiovascular monitoring devices was not considered in the economic model because of the lack of data and/or unsuitability for the UK setting. Given the heterogeneity in the components of usual care and RM interventions, the cost-effectiveness analysis was performed using a set of costing scenarios designed to reflect the different configurations of usual care and RM in the UK. RESULTS: The literature searches identified 3060 citations. Six RCTs met the inclusion criteria and were added to the 15 trials identified from the previous systematic reviews giving a total of 21 RCTs included in the systematic review. No trials of cardiovascular implanted monitoring devices or observational studies met the inclusion criteria. The methodological quality of the studies varied widely and reporting was generally poor. Compared with usual care, RM was beneficial in reducing all-cause mortality for STS HH [hazard ratio (HR) 0.77, 95% credible interval (CrI) 0.55 to 1.08], TM during office hours (HR 0.76, 95% CrI 0.49 to 1.18) and TM 24/7 (HR 0.49, 95% CrI 0.20 to 1.18); however, these results were statistically inconclusive. The results for TM 24/7 should be treated with caution because of the poor methodological quality of the only included study in this network. No favourable effect on mortality was observed with STS HM. Similar reductions were observed in all-cause hospitalisations for TM interventions, whereas STS interventions had no major effect. A sensitivity analysis, in which a study was excluded because it provided better-than-usual support to the control group, showed larger beneficial effects for most outcomes, particularly for TM during office hours. In the cost-effectiveness analyses, TM during office hours was the most cost-effective strategy with an estimated incremental cost-effectiveness ratio (ICER) of pound11,873 per quality-adjusted life-year (QALY) compared with usual care, whereas STS HH had an ICER of pound228,035 per QALY compared with TM during office hours. STS HM was dominated by usual care. Similar results were observed in scenario analyses performed using higher costs of usual care, higher costs of STS HH and lower costs of TM during office hours. LIMITATIONS: The RM interventions included in the review were heterogeneous in terms of monitored parameters and HF selection criteria and lacked detail in the components of the RM care packages and usual care (e.g. communication protocols, routine staff visits and resources used). As a result, the economic model developed scenarios for different RM classifications and their costs were estimated using bottom-up costing methods. Although the users can decide which of these scenarios is most representative of their setting, uncertainties still remain about the assumptions made in the estimation of these costs. In addition, the model assumed that the effectiveness of the interventions was constant over time, irrespective of the duration of deployment, and that the intervention was equally effective in different age/severity groups. CONCLUSION: Despite wide variation in usual care and RM strategies, cost-effectiveness analyses suggest that TM during office hours was an optimal strategy (in most costing scenarios). However, clarity was lacking among descriptions of the components of RM packages and usual care and there was a lack of robust estimation of costs. Further research is needed in these areas. STUDY REGISTRATION: PROSPERO registration no. CRD42011001368. FUNDING: The National Institute for Health Research Health Technology Assessment programme.

Pare, G., Moqadem, K., Pineau, G., et al. (2010). "Clinical effects of home telemonitoring in the context of diabetes, asthma, heart failure and hypertension: a systematic review." *J Med Internet Res* **12**(2): e21.

BACKGROUND: Home telemonitoring figures among the various solutions that could help attenuate some of the problems associated with aging populations, rates of chronic illness, and shortages of health professionals. OBJECTIVE: The primary aim of this study was to further our understanding of the clinical effects associated with home telemonitoring programs in the context of chronic diseases. METHODS: We conducted a systematic review

which covered studies published between January 1966 and December 2008. MEDLINE, The Cochrane Library, and the INAHTA (International Network of Agencies for Health Technology Assessment) database were consulted. Our inclusion criteria consisted of: (1) English language publications in peer-reviewed journals or conference proceedings and (2) studies involving patients with diabetes, asthma, heart failure, or hypertension, and presenting results on the clinical effects of home telemonitoring. RESULTS: In all, 62 empirical studies were analyzed. The results from studies involving patients with diabetes indicated a trend toward patients with home telemonitoring achieving better glycemic control. In most trials in which patients with asthma were enrolled, results showed significant improvements in patients' peak expiratory flows, significant reductions in the symptoms associated with this illness, and improvements in perceived quality of life. Virtually all studies involving patients with hypertension demonstrated the ability of home telemonitoring to reduce systolic and/or diastolic blood pressure. Lastly, due to the equivocal nature of current findings of home telemonitoring involving patients with heart failure, larger trials are still needed to confirm the clinical effects of this technology for these patients. CONCLUSIONS: Although home telemonitoring appears to be a promising approach to patient management, designers of future studies should consider ways to make this technology more effective as well as controlling possible mediating variables.

Peretz, D., Arnaert, A. et Ponzoni, N. N. (2018). "Determining the cost of implementing and operating a remote patient monitoring programme for the elderly with chronic conditions: A systematic review of economic evaluations." *J Telemed Telecare* **24**(1): 13-21.

Introduction Remote patient monitoring (RPM) in conjunction with home nursing visits is becoming increasingly popular for the follow-up of patients with chronic conditions and evidence exists that it improves patients' health outcomes. Current cost data is reported inconsistently and often gathered from studies of poor methodological quality, making it difficult for decision-makers who consider implementing this service in their organizations. This study reviewed the cost of RPM programmes targeting elderly patients with chronic conditions. **Methods** After evaluation against the inclusion and exclusion criteria and appraisal against two criteria which are important for economic evaluations, data from selected studies were extracted and grouped into meaningful cost categories, then adjusted to reflect November 2015 US dollars. **Results** In the 13 selected studies, the newly-created cost category 'Combined intervention cost' (reflecting equipment purchasing, servicing and monitoring cost) for the various RPM programmes ranged from US\$275-US\$7963 per patient per year. The three main findings are: (a) RPM programme costs have decreased since 2004 due to cheaper technology; (b) monitoring a single vital sign is likely to be less costly than monitoring multiple vital signs; and (c) programmes targeting hypertension or congestive heart failure are less costly than those targeting respiratory diseases or multiple conditions. **Conclusions** This review recommends that future studies present their cost data with more granularity, that grouping of costs should be minimized and that any assumptions, such as amortization, should be made explicit. In addition, studies should compare programmes with similar characteristics in terms of type of conditions, number of vital signs monitored, etc. for more generalizable results.

Purcell, R., McInnes, S. et Halcomb, E. J. (2014). "Telemonitoring can assist in managing cardiovascular disease in primary care: a systematic review of systematic reviews." *BMC Fam Pract* **15**: 43.

BACKGROUND: There has been growing interest regarding the impact of telemonitoring and its ability to reduce the increasing burden of chronic diseases, including chronic cardiovascular disease (CVD), on healthcare systems. A number of randomised trials have

been undertaken internationally and synthesised into various systematic reviews to establish an evidence base for this model of care. This study sought to synthesise and critically evaluate this large body of evidence to inform clinicians, researchers and policy makers. METHODS: A systematic review of systematic reviews investigating the impact of telemonitoring interventions in the primary care management of CVD was conducted. Reviews were included if they explored primary care based telemonitoring in either CVD, heart failure or hypertension, were reported in the English language and were published between 2000 and 2013. Data was extracted by one reviewer and checked by a second reviewer using a standardised form. Two assessors then rated the quality of each review using the Overview Quality Assessment Questionnaire (OQAQ). RESULTS: Of the 13 included reviews, four focused on telemonitoring interventions in hypertension or CVD management and the remaining 9 reviews investigated telemonitoring in HF management. Seven reviews scored a five or above on the OQAQ evidencing good quality reviews. Findings suggest that telemonitoring can contribute to significant reductions in blood pressure, decreased all-cause and HF related hospitalisations, reduced all-cause mortality and improved quality of life. Telemonitoring was also demonstrated to reduce health care costs and appears acceptable to patients. CONCLUSION: Telemonitoring has the potential to enhance primary care management of CVD by improving patient outcomes and reducing health costs. However, further research needs to explore the specific elements of telemonitoring interventions to determine the relative value of the various elements. Additionally, the ways in which telemonitoring care improves health outcomes needs to be further explored to understand the nature of these interventions.

Van Spall, H. G. C., Rahman, T., Mytton, O., et al. (2017). "Comparative effectiveness of transitional care services in patients discharged from the hospital with heart failure: a systematic review and network meta-analysis." *Eur J Heart Fail* **19**(11): 1427-1443.

AIMS: To compare the effectiveness of transitional care services in decreasing all-cause death and all-cause readmissions following hospitalization for heart failure (HF). METHODS AND RESULTS: We searched PubMed, Embase, CINAHL, and Cochrane Clinical Trials Register for randomized controlled trials (RCTs) published in 2000-2015 that tested the efficacy of transitional care services in patients hospitalized for HF, provided ≥ 1 month of follow-up, and reported all-cause mortality or all-cause readmissions. Our network meta-analysis included 53 RCTs (12 356 patients). Among services that significantly decreased all-cause mortality compared with usual care, nurse home visits were most effective [ranking P-score 0.6794; relative risk (RR) 0.78, 95% confidence intervals (CI) 0.62-0.98], followed by disease management clinics (DMCs) (ranking P-score 0.6368; RR 0.80, 95% CI 0.67-0.97). Among services that significantly decreased all-cause readmission, nurse home visits were most effective [ranking P-score 0.8365; incident rate ratio (IRR) 0.65, 95% CI 0.49-0.86], followed by nurse case management (NCM) (ranking P-score 0.6168; IRR 0.77, 95% CI 0.63-0.95), and DMCs (ranking P-score 0.5691; IRR 0.80, 95% CI 0.66-0.97). There was no significant difference in the comparative effectiveness of services that improved each outcome. Nurse home visits had the greatest pooled cost-savings (3810 USD, 95% CI 3682-3937), followed by NCM (3435 USD, 95% CI 3224-3645), and DMCs (245 USD, 95% CI -70 to 559). Telephone, telemonitoring, pharmacist, and education interventions did not significantly improve clinical outcomes. CONCLUSION: Nurse home visits and DMCs decrease all-cause mortality after hospitalization for HF. Along with NCM, they also reduce all-cause readmissions, with no significant difference in comparative effectiveness. These services reduce healthcare system costs to varying degrees.

Wootton, R. (2012). "Twenty years of telemedicine in chronic disease management--an evidence synthesis." *J Telemed Telecare* **18**(4): 211-220.

A literature review was conducted to obtain a high-level view of the value of telemedicine in the management of five common chronic diseases (asthma, COPD, diabetes, heart failure, hypertension). A total of 141 randomised controlled trials (RCTs) was identified, in which 148 telemedicine interventions of various kinds had been tested in a total of 37,695 patients. The value of each intervention was categorised in terms of the outcomes specified by the investigators in that trial, i.e. no attempt was made to extract a common outcome from all studies, as would be required for a conventional meta-analysis. Summarizing the value of these interventions shows, first, that most studies have reported positive effects (n = 108), and almost none have reported negative effects (n = 2). This suggests publication bias. Second, there were no significant differences between the chronic diseases, i.e. telemedicine seems equally effective (or ineffective) in the diseases studied. Third, most studies have been relatively short-term (median duration 6 months). It seems unlikely that in a chronic disease, any intervention can have much effect unless applied for a long period. Finally, there have been very few studies of cost-effectiveness. Thus the evidence base for the value of telemedicine in managing chronic diseases is on the whole weak and contradictory.

LES ETUDES D'ÉVALUATION CLINIQUE : REVUES DE LITTÉRATURE

Augustin, U. et Henschke, C. (2012). "[Does telemonitoring lead to health and economic benefits in patients with chronic heart failure? - a systematic review]." *Gesundheitswesen* **74**(12): e114-121.

Chronic heart failure is a severe and common disease combined with high costs for the German health care system. Deficiencies in standard therapy and limited financial capacities of the German health care system necessitate new approaches in the care of chronic heart failure patients. The present study aims to analyse the scientific level of knowledge of clinical, economic and other outcomes of telemonitoring compared with standard therapy for patients with chronic heart failure. Results should provide an evidence base for health-care decision makers. To determine the outcomes, a systematic review was carried out by using the database MEDLINE. In accordance with defined inclusion and exclusion criteria, 10 randomized controlled trials remained. Furthermore, 4 studies of a hand research and the recently published results of one of the largest national studies were included. As a result of the systematic review, there is currently no evidence for the benefits of telemonitoring compared with standard therapy. National studies identified significant improvements or a tendency for improvements in terms of quality of life and costs/cost-effectiveness as well as partly in mortality, hospital duration and medication adherence. International studies diverged in their results. The comparability and validity of the investigated studies are limited due to a low number of national studies, different settings of the telemonitoring programmes, the inclusion of different NYHA classes, the heterogeneity of study endpoints and endpoint-related causes, short observation periods of some studies as well as questionable transferability of international cost-results to the German health care system. Furthermore, differences in standard therapy between national and international studies were identified. None of the international studies performed a comparison between clinical and economic outcomes. With regard to the future prospects of telemonitoring in Germany there is still a need for further high quality studies (particularly on the national level) concerning the clinical, economic and other outcomes of telemonitoring compared with standard therapy. Clear evidence is a sine qua non for telemonitoring's inclusion in the benefits catalogue of the statutory health insurance. For a better comparability of studies, standardised telemonitoring programmes and study criteria should be developed and applied.

Bashi, N., Karunanithi, M., Fatehi, F., et al. (2017). "Remote Monitoring of Patients With Heart Failure: An Overview of Systematic Reviews." *J Med Internet Res* **19**(1): e18.

BACKGROUND: Many systematic reviews exist on the use of remote patient monitoring (RPM) interventions to improve clinical outcomes and psychological well-being of patients with heart failure. However, research is broadly distributed from simple telephone-based to complex technology-based interventions. The scope and focus of such evidence also vary widely, creating challenges for clinicians who seek information on the effect of RPM interventions. **OBJECTIVE:** The aim of this study was to investigate the effects of RPM interventions on the health outcomes of patients with heart failure by synthesizing review-level evidence. **METHODS:** We searched PubMed, EMBASE, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and the Cochrane Library from 2005 to 2015. We screened reviews based on relevance to RPM interventions using criteria developed for this overview. Independent authors screened, selected, and extracted information from systematic reviews. AMSTAR (Assessment of Multiple Systematic Reviews) was used to assess the methodological quality of individual reviews. We used standardized language to summarize results across reviews and to provide final statements about intervention effectiveness. **RESULTS:** A total of 19 systematic reviews met our inclusion criteria. Reviews consisted of RPM with diverse interventions such as telemonitoring, home telehealth, mobile phone-based monitoring, and videoconferencing. All-cause mortality and heart failure mortality were the most frequently reported outcomes, but others such as quality of life, rehospitalization, emergency department visits, and length of stay were also reported. Self-care and knowledge were less commonly identified. **CONCLUSIONS:** Telemonitoring and home telehealth appear generally effective in reducing heart failure rehospitalization and mortality. Other interventions, including the use of mobile phone-based monitoring and videoconferencing, require further investigation.

Blair, T. L. (2014). "Device diagnostics and early identification of acute decompensated heart failure: a systematic review." *J Cardiovasc Nurs* **29**(1): 68-81.

BACKGROUND: Traditional methods of heart failure (HF) management are based on reactive strategies to treat late indicators of decompensated HF. Advances in monitoring methods have become available with the evolution of implantable cardioverter-defibrillators and cardiac-resynchronization therapy devices. These devices provide new diagnostic data and remote monitoring capabilities that allow clinicians to proactively monitor patients for earlier signs of worsening HF. The integration of data obtained from implantable cardioverter-defibrillator and cardiac-resynchronization therapy technology could improve outpatient HF care, potentially leading to decreased readmission rates and improved patient outcomes. **OBJECTIVE:** This review will synthesize the literature regarding the efficacy of device diagnostic data and the usability of the data in the clinical setting. **METHODS:** Articles for review were obtained using Cumulative Index to Nursing and Allied Health Literature, MEDLINE, PubMed, and ClinicalTrials.gov. **RESULTS:** Device diagnostics showed strong correlation with established HF biomarkers and hemodynamic measures. The findings from this review indicate that device diagnostic parameters predict impending HF much earlier than traditional methods of monitoring do. Device diagnostics are also more accurate in the early prediction of HF when compared with noninvasive objective measures, particularly when multiple parameters are combined and monitored for trends. Device diagnostics possess a distinct advantage over traditional methods of monitoring for HF because they allow clinicians to remotely monitor the status of their HF patients without relying on patient compliance for data entry and reporting. **CONCLUSIONS:** Studies regarding the efficacy of device diagnostic parameters suggest that their integration into clinical practice will provide

a more accurate and reliable mechanism for assisting clinicians in risk stratifying and predicting potential episodes of decompensated HF.

Brewster, L., Mountain, G., Wessels, B., et al. (2014). "Factors affecting front line staff acceptance of telehealth technologies: a mixed-method systematic review." *J Adv Nurs* **70**(1): 21-33.

AIM: To synthesize qualitative and quantitative evidence of front-line staff acceptance of the use of telehealth technologies for the management of Chronic Obstructive Pulmonary Disease and Chronic Heart Failure. BACKGROUND: The implementation of telehealth at scale is a governmental priority in countries including the UK, USA and Canada, but little research has been conducted to analyse the impact of implementation on front-line nursing staff. DATA SOURCES: Six relevant data bases were searched between 2000-2012. DESIGN: Mixed-method systematic review including all study designs. REVIEW METHODS: Centre for Reviews and Dissemination approach with thematic analysis and narrative synthesis of results. RESULTS: Fourteen studies met the review inclusion criteria; 2 quantitative surveys, 2 mixed-method studies and 10 using qualitative methods, including focus groups, interviews, document analysis and observations. Identified factors affecting staff acceptance centred on the negative impact of service change, staff-patient interaction, credibility and autonomy, and technical issues. Studies often contrasted staff and patient perspectives, and data about staff acceptance were collected as part of a wider study, rather than being the focus of data collection, meaning data about staff acceptance were limited. CONCLUSION: If telehealth is to be implemented, studies indicate that the lack of acceptance of this new way of working may be a key barrier. However, recommendations have not moved beyond barrier identification to recognizing solutions that might be implemented by front-line staff. Such solutions are imperative if future roll-out of telehealth technologies is to be successfully achieved.

Brons, M., Koudstaal, S. et Asselbergs, F. W. (2018). "Algorithms used in telemonitoring programmes for patients with chronic heart failure: A systematic review." *Eur J Cardiovasc Nurs* **17**(7): 580-588.

INTRODUCTION: Non-invasive telemonitoring programmes detecting deterioration of heart failure are increasingly used in heart failure care. AIM: The aim of this study was to compare different monitoring algorithms used in non-invasive telemonitoring programmes for patients with chronic heart failure. METHODS: We performed a systematic literature review in MEDLINE (PubMed) and Embase to identify published reports on non-invasive telemonitoring programmes in patients with heart failure aged over 18 years. RESULTS: Out of 99 studies included in the study, 20 (20%) studies described the algorithm used for monitoring worsening heart failure or algorithms used for titration of heart failure medication. Most frequently used biometric measurements were bodyweight (96%), blood pressure (85%) and heart rate (61%). Algorithms to detect worsening heart failure were based on daily changes in bodyweight in 20 (100%) studies and/or blood pressure in 12 (60%) studies. In 12 (60%) studies patients were contacted by telephone in the case of measurements outside thresholds. CONCLUSION: Only one in five studies on telemonitoring in chronic heart failure reported the algorithm that was used to detect worsening heart failure. Standardised description of the telemonitoring algorithm can expedite the identification of key components in telemonitoring algorithms that allow accurate prediction of worsening heart failure.

Cajita, M. I., Gleason, K. T. et Han, H. R. (2016). "A Systematic Review of mHealth-Based Heart Failure Interventions." *J Cardiovasc Nurs* **31**(3): E10-22.

BACKGROUND: The popularity of mobile phones and similar mobile devices makes it an ideal medium for delivering interventions. This is especially true with heart failure (HF) interventions, in which mHealth-based HF interventions are rapidly replacing their telephone-based predecessors. **PURPOSE:** This systematic review examined the impact of mHealth-based HF management interventions on HF outcomes. The specific aims of the systematic review are to (1) describe current mHealth-based HF interventions and (2) discuss the impact of these interventions on HF outcomes. **METHODS:** PubMed, CINAHL Plus, EMBASE, PsycINFO, and Scopus were systematically searched for randomized controlled trials or quasi-experimental studies that tested mHealth interventions in people with HF using the terms Heart Failure, Mobile Health, mHealth, Telemedicine, Text Messaging, Texting, Short Message Service, Mobile Applications, and Mobile Apps. **CONCLUSIONS:** Ten articles, representing 9 studies, were included in this review. The majority of the studies utilized mobile health technology as part of an HF monitoring system, which typically included a blood pressure-measuring device, weighing scale, and an electrocardiogram recorder. The impact of the mHealth interventions on all-cause mortality, cardiovascular mortality, HF-related hospitalizations, length of stay, New York Heart Association functional class, left ventricular ejection fraction, quality of life, and self-care were inconsistent at best. **IMPLICATIONS:** Further research is needed to conclusively determine the impact of mHealth interventions on HF outcomes. The limitations of the current studies (eg, inadequate sample size, quasi-experimental design, use of older mobile phone models, etc) should be taken into account when designing future studies.

Cherofsky, N., Onua, E., Sawo, D., et al. (2011). "Telehealth in adult patients with congestive heart failure in long term home health care: a systematic review." *JBI Libr Syst Rev* **9**(30): 1271-1296.

BACKGROUND: Congestive heart failure results in clinical signs of edema, shortness of breath, and decreased quality of life. The effective management of patients with congestive heart failure in long term home care settings is important in reducing rehospitalization, emergency department visits and improving quality of life. Telehealth interventions following hospital discharge in various settings have been reported in the published literature as having an impact on decreasing emergency department visits, rehospitalization and quality of life. The data on its effectiveness with patients in a long term home health agency program however, is limited. **OBJECTIVE:** The purpose of this systematic review was to find and report on the best available evidence related to the effectiveness of telehealth interventions on specific outcomes in adult patients with congestive heart failure in a long term home health care setting. **SEARCH STRATEGY:** The search strategy identified both published and unpublished literature in the English language from 1995 to 2010. A range of electronic databases were searched including CINAHL, MEDLINE, EMBASE and COCHRANE. **INCLUSION CRITERIA:** Adult patients 18 years and older with a diagnosis of congestive heart failure receiving long term care from a home health care agency were considered in this review. Interventions of interest were telemonitoring and telephone follow-up calls with usual care as the comparator. Outcome measures were rehospitalizations rates, emergency department visit rates, and patients' perceived quality of life. Randomized controlled trials and quasi-experimental studies addressing the interventions of interest were selected. **DATA COLLECTION AND ANALYSIS:** The included studies were evaluated independently by two reviewers for methodological quality using The Joanna Briggs institute appraisal and extraction tools. **MAIN RESULTS:** Three randomized controlled trials and two quasi-experimental studies with a total of 612 patients were included in the review. Two randomized controlled trials and one quasi-experimental study evaluated telemonitoring. One quasi-experimental study evaluated structured nursing and telephone visits and the other randomized control trial evaluated in-home visits supplemented by telephone calls. Among the telemonitoring studies only one had a statistically significant reduction in ED

12(26.1%) $P < 0.001$ and hospital admission rates 13(28.3%) $P < 0.001$. Two quasi-experimental trials showed improvement in quality of life but in one there was no comparison with the control group. The randomized controlled trial did not evaluate quality of life as an outcome. CONCLUSIONS: The results of this review were equivocal. Only one randomized control trial demonstrated statistically significant results in reducing emergency department visits and hospital readmissions, and the sample size for this study was small. IMPLICATIONS FOR PRACTICE: The key to improving quality of life and reducing emergency department and rehospitalization rates is to develop interventions that will be effective when implemented into practice. IMPLICATIONS FOR RESEARCH: Research evaluating the role of telehealth in the management of congestive heart failure patients in long term home care agency is in its infancy. There needs to be well designed randomized control trials with larger sample sizes, of longer duration, and appropriately powered to evaluate different interventions.

Ciere, Y., Cartwright, M. et Newman, S. P. (2012). "A systematic review of the mediating role of knowledge, self-efficacy and self-care behaviour in telehealth patients with heart failure." J Telemed Telecare **18**(7): 384-391.

We conducted a systematic review of controlled trials and pre-post studies to examine whether the putative benefits of telehealth, notably, improvements in clinical outcomes and quality of life, are mediated by increases in knowledge, self-efficacy and self-care behaviour in patients with heart failure. Telehealth was defined as any system of home-based self-monitoring of signs or symptoms of heart failure that transferred data for remote assessment by healthcare providers. Seven electronic databases were searched for studies that assessed any of six pathways in a proposed model. Data were independently extracted by two reviewers. Twelve studies met the inclusion criteria and provided evidence for or against one or more of the six pathways. Although all of the pathways in the model can be theoretically justified and three of the six relationships have been established in heart failure samples outside the context of telehealth, none of the pathways in the model were supported by the telehealth studies reviewed. Failure to replicate previously established relationships emphasizes the weakness of the telehealth literature, which impedes our ability to address questions such as how telehealth might achieve beneficial outcomes.

Conway, A., Inglis, S. C., Chang, A. M., et al. (2013). "Not all systematic reviews are systematic: a meta-review of the quality of systematic reviews for non-invasive remote monitoring in heart failure." J Telemed Telecare **19**(6): 326-337.

We carried out a critical appraisal and synthesis of the systematic reviews and meta-analyses of remote monitoring for heart failure. A comprehensive literature search identified 65 relevant publications from 3333 citations. Seventeen studies fulfilled the inclusion and exclusion criteria. Seven (41%) systematic reviews pooled results for meta-analysis. Eight (47%) considered all non-invasive remote monitoring strategies. Five (29%) focused on telemonitoring. Four (24%) included both non-invasive and invasive technologies. The reviews were appraised by two independent reviewers for their quality and risk of bias using the AMSTAR tool. According to the AMSTAR criteria, ten (58%) systematic reviews were of poor methodological quality. In the high quality reviews, the relative risk of mortality in patients who received remote monitoring ranged from 0.53 to 0.88. The high quality reviews also reported that remote monitoring reduced the relative risk of all-cause (0.52 to 0.96) and heart failure-related hospitalizations (0.72 to 0.79) and, as a consequence, healthcare costs. However, further research is required before considering widespread implementation of remote monitoring. The subset of the heart failure population that derives the most benefit

from intensive monitoring, the best technology, and the optimum duration of monitoring, all need to be identified.

Corral Gudino, L., Borao Cengotita-Bengoia, M., Jorge Sanchez, R. J., et al. (2017). "[The patient and the crossing between Primary and Hospital care. Systematic review of trials for the implementation of tools for integration in Spain]." *An Sist Sanit Navar* **40**(3): 443-459.

BACKGROUND: Health services are moving towards a complete integration to try and reduce fragmentation, increase efficiencies and improve health outcomes. Estimates the effectiveness in of different tools for integrated care in Spain. **METHODS:** We performed a systematic review of articles using MEDLINE (last search July 31st, 2017). Randomized clinical trials reporting health outcomes of tools for integrated care used in Spain were included. Studies were appraised for quality using the Cochrane Risk of Bias assessment. **RESULTS:** Twenty studies met the criteria for the systematic review. Interventions included were hospital-at-home (four studies, 455 patients), outpatient clinic by videoconference (three studies, 2438 patients), nurse navigator (four studies, 1051 patients), self-care improvement (four studies, 1291 patients), at-home health monitoring (three, 162), health apps (two, 225) and medical reconciliation (one, 172). Hospital-at-home, nurse navigator or self-care improvement reduced readmission rate in older patients, heart failure (HF) or chronic obstructive pulmonary disease (COPD). Self-care improvement and nurse navigator reduced mortality rate in HF. Hospital-at-home reduced hospital stay in COPD. Self-care improvement reduced outpatient visits in asthma patients. Outpatient video by videoconference reduced time to diagnosis and treatment in rural areas. The quality of the evidence ranged from low to very low for all the outcomes because it was based in double or triple downgraded randomized trials. **CONCLUSION:** The implementation of tools for integrated care in Spain improved some outcomes of relevance in patients with chronic conditions, although evidence is low. Self-care improvement stood out due to the improvements made.

de la Torre Diez, I., Garcia-Zapirain, B., Mendez-Zorrilla, A., et al. (2016). "Monitoring and Follow-up of Chronic Heart Failure: a Literature Review of eHealth Applications and Systems." *J Med Syst* **40**(7): 179.

In developed countries heart failure is one of the most important causes of death, followed closely by strokes and other cerebrovascular diseases. It is one of the major healthcare issues in terms of increasing number of patients, rate of hospitalizations and costs. The main aim of this paper is to present telemedicine applications for monitoring and follow-up of heart failure and to show how these systems can help reduce costs of administering heart failure. The search for e-health applications and systems in the field of telemonitoring of heart failure was pursued in IEEE Xplore, Science Direct, PubMed and Scopus systems between 2005 and the present time. This search was conducted between May and June 2015, and the articles deemed to be of most interest about treatment, prevention, self-empowerment and stabilization of patients were selected. Over 100 articles about telemonitoring of heart failure have been found in the literature reviewed since 2005, although the most interesting ones have been selected from the scientific standpoint. Many of them show that telemonitoring of patients with a high risk of heart failure is a measure that might help to reduce the risk of suffering from the disease. Following the review conducted, it can be stated that via the research articles analysed that telemonitoring systems can help to reduce the costs of administering heart failure and result in less re-hospitalization of patients.

de Waure, C., Cadeddu, C., Gualano, M. R., et al. (2012). "Telemedicine for the reduction of myocardial infarction mortality: a systematic review and a meta-analysis of published studies." *Telemed J E Health* **18**(5): 323-328.

INTRODUCTION: Advances in electronics and communications have changed modern medicine: telemedicine allows patient assessment and monitoring to facilitate healthcare at a distance. The aim of this study was to perform a systematic review and meta-analysis to assess how telemedicine systems, including early telemetry of electrocardiograms, can improve health outcomes in patients with coronary artery disease and, in particular, acute myocardial infarction (AMI). **METHODS:** Studies dealing with telemedicine applications in managing AMI that were conducted before January 22, 2010, published in English or Italian, were identified in PubMed and ISI Web of Knowledge searches. The meta-analysis was performed to assess the efficacy of telemedicine versus standard measures in reducing mortality. Relative risk (RR) with 95% confidence interval was used to report results and the I² test to evaluate heterogeneity. **RESULTS:** Five of the 39 articles retrieved were selected; all studies demonstrated the efficacy of telemedicine applications. Only three studies were judged to be comparable and suitable for combining data. This meta-analysis showed that the RR for in-hospital mortality from AMI was 0.65 (95% confidence interval, 0.42-0.99) for the telemedicine group, without heterogeneity. **CONCLUSIONS:** Telemedicine may improve health outcomes of patients with AMI. However, heterogeneity in study design and end points of most studies limited the number of articles that could be subjected to our meta-analysis.

Dennis, S. M., Harris, M., Lloyd, J., et al. (2013). "Do people with existing chronic conditions benefit from telephone coaching? A rapid review." *Aust Health Rev* **37**(3): 381-388.

OBJECTIVE: To examine the effectiveness of telephone-based coaching services for the management of patients with chronic diseases. **METHODS:** A rapid scoping review of the published peer reviewed literature, using Medline, Embase, CINAHL, PsychNet and Scopus. We included studies involving people aged 18 years or over with one or more of the following chronic conditions: type 2 diabetes, congestive cardiac failure, coronary artery disease, chronic obstructive pulmonary disease and hypertension. Patients were identified as having multi-morbidity if they had an index chronic condition plus one or more other chronic condition. To be included in this review, the telephone coaching had to involve two-way conversations by telephone or video phone between a patient and a provider. Behaviour change, goal setting and empowerment are essential features of coaching. **RESULTS:** The review found 1756 papers, which was reduced to 30 after screening and relevance checks. Most coaching services were planned, as opposed to reactive, and targeted patients with complex needs who had one or more chronic disease. Several studies reported improvements in health behaviour, self-efficacy, health status and satisfaction with the service. More than one-third of the papers targeted vulnerable people and telephone coaching was found to be effective for these people. **CONCLUSIONS:** Telephone coaching for people with chronic conditions can improve health behaviour, self-efficacy and health status. This is especially true for vulnerable populations who had difficulty accessing health services. There is less evidence for improvements in quality of life and patient satisfaction with the service. The evidence for improvements in health service use was limited. This rapid scoping review found that telephone-based coaching can enhance the management of chronic disease, especially for vulnerable groups. Further work is needed to identify what models of telephone coaching are most effective according to patients' level of risk and co-morbidity. What is known about the topic? With the increasing prevalence of chronic diseases more demands are being made of limited health services and resources. Telephone health coaching for people with or at risk of chronic diseases is seen as a means of supporting people to manage their health and reducing the burden on the healthcare system. What does this paper add? Telephone coaching interventions were effective for vulnerable people with chronic disease(s). Often the vulnerable populations had worse control of their chronic

condition at baseline and demonstrated the greatest improvement compared with those with better control at baseline. Planned (i.e. weekly or monthly telephone calls to support the patients with chronic disease) and unscripted telephone coaching interventions appear to be most effective for improving self-management skills in people from vulnerable groups: the planned telephone coaching services had the advantage of regular contact and helping people develop their skills over time, whereas the unscripted aspect allowed the coach to tailor support to the patient's individual needs. What are the implications for practitioners? Telephone coaching is an effective means of supporting people with chronic diseases to manage their own health. Further work is needed to embed telephone coaching within existing services. Good linkages with the patient's general practitioner are important. This might be a regular report, updates via the patient e-health record, or provision for contact if a problem is identified or linking to the patient e-health record.

Dennis, S. M., Harris, M., Lloyd, J., et al. (2013). "Do people with existing chronic conditions benefit from telephone coaching? A rapid review." *Aust Health Rev* **37**(3): 381-388.

OBJECTIVE: To examine the effectiveness of telephone-based coaching services for the management of patients with chronic diseases. **METHODS:** A rapid scoping review of the published peer reviewed literature, using Medline, Embase, CINAHL, PsychNet and Scopus. We included studies involving people aged 18 years or over with one or more of the following chronic conditions: type 2 diabetes, congestive cardiac failure, coronary artery disease, chronic obstructive pulmonary disease and hypertension. Patients were identified as having multi-morbidity if they had an index chronic condition plus one or more other chronic condition. To be included in this review, the telephone coaching had to involve two-way conversations by telephone or video phone between a patient and a provider. Behaviour change, goal setting and empowerment are essential features of coaching. **RESULTS:** The review found 1756 papers, which was reduced to 30 after screening and relevance checks. Most coaching services were planned, as opposed to reactive, and targeted patients with complex needs who had one or more chronic disease. Several studies reported improvements in health behaviour, self-efficacy, health status and satisfaction with the service. More than one-third of the papers targeted vulnerable people and telephone coaching was found to be effective for these people. **CONCLUSIONS:** Telephone coaching for people with chronic conditions can improve health behaviour, self-efficacy and health status. This is especially true for vulnerable populations who had difficulty accessing health services. There is less evidence for improvements in quality of life and patient satisfaction with the service. The evidence for improvements in health service use was limited. This rapid scoping review found that telephone-based coaching can enhance the management of chronic disease, especially for vulnerable groups. Further work is needed to identify what models of telephone coaching are most effective according to patients' level of risk and co-morbidity. What is known about the topic? With the increasing prevalence of chronic diseases more demands are being made of limited health services and resources. Telephone health coaching for people with or at risk of chronic diseases is seen as a means of supporting people to manage their health and reducing the burden on the healthcare system. What does this paper add? Telephone coaching interventions were effective for vulnerable people with chronic disease(s). Often the vulnerable populations had worse control of their chronic condition at baseline and demonstrated the greatest improvement compared with those with better control at baseline. Planned (i.e. weekly or monthly telephone calls to support the patients with chronic disease) and unscripted telephone coaching interventions appear to be most effective for improving self-management skills in people from vulnerable groups: the planned telephone coaching services had the advantage of regular contact and helping people develop their skills over time, whereas the unscripted aspect allowed the coach to tailor support to the patient's individual needs. What are the implications for practitioners?

Telephone coaching is an effective means of supporting people with chronic diseases to manage their own health. Further work is needed to embed telephone coaching within existing services. Good linkages with the patient's general practitioner are important. This might be a regular report, updates via the patient e-health record, or provision for contact if a problem is identified or linking to the patient e-health record.

Farnia, T., Jaulent, M. C. et Steichen, O. (2018). "Evaluation Criteria of Noninvasive Telemonitoring for Patients With Heart Failure: Systematic Review." *J Med Internet Res* **20**(1): e16.

BACKGROUND: Telemonitoring can improve heart failure (HF) management, but there is no standardized evaluation framework to comprehensively evaluate its impact. **OBJECTIVE:** Our objectives were to list the criteria used in published evaluations of noninvasive HF telemonitoring projects, describe how they are used in the evaluation studies, and organize them into a consistent scheme. **METHODS:** Articles published from January 1990 to August 2015 were obtained through MEDLINE, Web of Science, and EMBASE. Articles were eligible if they were original reports of a noninvasive HF telemonitoring evaluation study in the English language. Studies of implantable telemonitoring devices were excluded. Each selected article was screened to extract the description of the telemonitoring project and the evaluation process and criteria. A qualitative synthesis was performed. **RESULTS:** We identified and reviewed 128 articles leading to 52 evaluation criteria classified into 6 dimensions: clinical, economic, user perspective, educational, organizational, and technical. The clinical and economic impacts were evaluated in more than 70% of studies, whereas the educational, organizational, and technical impacts were studied in fewer than 15%. User perspective was the most frequently covered dimension in the development phase of telemonitoring projects, whereas clinical and economic impacts were the focus of later phases. **CONCLUSIONS:** Telemonitoring evaluation frameworks should cover all 6 dimensions appropriately distributed along the telemonitoring project lifecycle. Our next goal is to build such a comprehensive evaluation framework for telemonitoring and test it on an ongoing noninvasive HF telemonitoring project.

Feltner, C., Jones, C. D., Cene, C. W., et al. (2014). "Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis." *Ann Intern Med* **160**(11): 774-784.

BACKGROUND: Nearly 25% of patients hospitalized with heart failure (HF) are readmitted within 30 days. **PURPOSE:** To assess the efficacy, comparative effectiveness, and harms of transitional care interventions to reduce readmission and mortality rates for adults hospitalized with HF. **DATA SOURCES:** MEDLINE, Cochrane Library, CINAHL, ClinicalTrials.gov, and World Health Organization International Clinical Trials Registry Platform (1 January 1990 to late October 2013). **STUDY SELECTION:** Two reviewers independently selected randomized, controlled trials published in English reporting a readmission or mortality rate within 6 months of an index hospitalization. **DATA EXTRACTION:** One reviewer extracted data, and another checked accuracy. Two reviewers assessed risk of bias and graded strength of evidence (SOE). **DATA SYNTHESIS:** Forty-seven trials were included. Most enrolled adults with moderate to severe HF and a mean age of 70 years. Few trials reported 30-day readmission rates. At 30 days, a high-intensity home-visiting program reduced all-cause readmission and the composite end point (all-cause readmission or death; low SOE). Over 3 to 6 months, home-visiting programs and multidisciplinary heart failure (MDS-HF) clinic interventions reduced all-cause readmission (high SOE). Home-visiting programs reduced HF-specific readmission and the composite end point (moderate SOE). Structured telephone support (STS) interventions reduced HF-specific readmission (high SOE) but not all-cause readmissions (moderate SOE). Home-visiting programs, MDS-HF clinics, and STS

interventions produced a mortality benefit. Neither telemonitoring nor primarily educational interventions reduced readmission or mortality rates. LIMITATIONS: Few trials reported 30-day readmission rates. Usual care was heterogeneous and sometimes not adequately described. CONCLUSION: Home-visiting programs and MDS-HF clinics reduced all-cause readmission and mortality; STS reduced HF-specific readmission and mortality. These interventions should receive the greatest consideration by systems or providers seeking to implement transitional care interventions for persons with HF. PRIMARY FUNDING SOURCE: Agency for Healthcare Research and Quality.

Flodgren, G., Rachas, A., Farmer, A. J., et al. (2015). "Interactive telemedicine: effects on professional practice and health care outcomes." *Cochrane Database Syst Rev*(9): Cd002098.

BACKGROUND: Telemedicine (TM) is the use of telecommunication systems to deliver health care at a distance. It has the potential to improve patient health outcomes, access to health care and reduce healthcare costs. As TM applications continue to evolve it is important to understand the impact TM might have on patients, healthcare professionals and the organisation of care. OBJECTIVES: To assess the effectiveness, acceptability and costs of interactive TM as an alternative to, or in addition to, usual care (i.e. face-to-face care, or telephone consultation). SEARCH METHODS: We searched the Effective Practice and Organisation of Care (EPOC) Group's specialised register, CENTRAL, MEDLINE, EMBASE, five other databases and two trials registers to June 2013, together with reference checking, citation searching, handsearching and contact with study authors to identify additional studies. SELECTION CRITERIA: We considered randomised controlled trials of interactive TM that involved direct patient-provider interaction and was delivered in addition to, or substituting for, usual care compared with usual care alone, to participants with any clinical condition. We excluded telephone only interventions and wholly automatic self-management TM interventions. DATA COLLECTION AND ANALYSIS: For each condition, we pooled outcome data that were sufficiently homogenous using fixed effect meta-analysis. We reported risk ratios (RR) and 95% confidence intervals (CI) for dichotomous outcomes, and mean differences (MD) for continuous outcomes. MAIN RESULTS: We included 93 eligible trials (N = 22,047 participants), which evaluated the effectiveness of interactive TM delivered in addition to (32% of studies), as an alternative to (57% of studies), or partly substituted for usual care (11%) as compared to usual care alone. The included studies recruited patients with the following clinical conditions: cardiovascular disease (36), diabetes (21), respiratory conditions (9), mental health or substance abuse conditions (7), conditions requiring a specialist consultation (6), co morbidities (3), urogenital conditions (3), neurological injuries and conditions (2), gastrointestinal conditions (2), neonatal conditions requiring specialist care (2), solid organ transplantation (1), and cancer (1). Telemedicine provided remote monitoring (55 studies), or real-time video-conferencing (38 studies), which was used either alone or in combination. The main TM function varied depending on clinical condition, but fell typically into one of the following six categories, with some overlap: i) monitoring of a chronic condition to detect early signs of deterioration and prompt treatment and advice, (41); ii) provision of treatment or rehabilitation (12), for example the delivery of cognitive behavioural therapy, or incontinence training; iii) education and advice for self-management (23), for example nurses delivering education to patients with diabetes or providing support to parents of very low birth weight infants or to patients with home parenteral nutrition; iv) specialist consultations for diagnosis and treatment decisions (8), v) real-time assessment of clinical status, for example post-operative assessment after minor operation or follow-up after solid organ transplantation (8) vi), screening, for angina (1). The type of data transmitted by the patient, the frequency of data transfer, (e.g. telephone, e-mail, SMS) and frequency of interactions between patient and healthcare provider varied across studies, as did the type of healthcare provider/s and healthcare system involved in

delivering the intervention. We found no difference between groups for all-cause mortality for patients with heart failure (16 studies; N = 5239; RR:0.89, 95% CI 0.76 to 1.03, P = 0.12; I(2) = 44%) (moderate to high certainty of evidence) at a median of six months follow-up. Admissions to hospital (11 studies; N = 4529) ranged from a decrease of 64% to an increase of 60% at median eight months follow-up (moderate certainty of evidence). We found some evidence of improved quality of life (five studies; N = 482; MD:-4.39, 95% CI -7.94 to -0.83; P < 0.02; I(2) = 0%) (moderate certainty of evidence) for those allocated to TM as compared with usual care at a median three months follow-up. In studies recruiting participants with diabetes (16 studies; N = 2768) we found lower glycated haemoglobin (HbA1c %) levels in those allocated to TM than in controls (MD -0.31, 95% CI -0.37 to -0.24; P < 0.00001; I(2) = 42%, P = 0.04) (high certainty of evidence) at a median of nine months follow-up. We found some evidence for a decrease in LDL (four studies, N = 1692; MD -12.45, 95% CI -14.23 to -10.68; P < 0.00001; I(2) = 0%) (moderate certainty of evidence), and blood pressure (four studies, N = 1770: MD: SBP:-4.33, 95% CI -5.30 to -3.35, P < 0.00001; I(2) = 17%; DBP: -2.75 95% CI -3.28 to -2.22, P < 0.00001; I(2) = 45% (moderate certainty evidence), in TM as compared with usual care. Seven studies that recruited participants with different mental health and substance abuse problems, reported no differences in the effect of therapy delivered over video-conferencing, as compared to face-to-face delivery. Findings from the other studies were inconsistent; there was some evidence that monitoring via TM improved blood pressure control in participants with hypertension, and a few studies reported improved symptom scores for those with a respiratory condition. Studies recruiting participants requiring mental health services and those requiring specialist consultation for a dermatological condition reported no differences between groups. AUTHORS' CONCLUSIONS: The findings in our review indicate that the use of TM in the management of heart failure appears to lead to similar health outcomes as face-to-face or telephone delivery of care; there is evidence that TM can improve the control of blood glucose in those with diabetes. The cost to a health service, and acceptability by patients and healthcare professionals, is not clear due to limited data reported for these outcomes. The effectiveness of TM may depend on a number of different factors, including those related to the study population e.g. the severity of the condition and the disease trajectory of the participants, the function of the intervention e.g., if it is used for monitoring a chronic condition, or to provide access to diagnostic services, as well as the healthcare provider and healthcare system involved in delivering the intervention.

Frederix, I., Hansen, D., Coninx, K., et al. (2015). "Telerehab III: a multi-center randomized, controlled trial investigating the long-term effectiveness of a comprehensive cardiac telerehabilitation program - rationale and study design." *BMC Cardiovasc Disord* **15**: 29.

BACKGROUND: Telerehabilitation has been proposed as an adjunct/alternative to standard center-based cardiac rehabilitation. Two recent systematic reviews showed non-inferiority and/or superiority of this remote approach for cardiac rehabilitation. However, these trials focused only on one core component of cardiac rehabilitation and telemonitoring, rather than implementing a more comprehensive approach. The aim of Telerehab III is to investigate the long-term effectiveness of the addition of a patient-tailored, internet-based telerehabilitation program implementing multiple cardiac rehabilitation core components and using both telemonitoring and telecoaching strategies to standard cardiac rehabilitation. METHODS/DESIGN: In this prospective, multi-center randomized, controlled trial 140 patients with coronary artery disease and/or chronic heart failure patients will be recruited between February 2013 and February 2015. Patients will be randomized 1:1 to an intervention group (receiving an internet-based telerehabilitation program in addition to standard cardiac rehabilitation) or to standard cardiac rehabilitation alone. The mean follow-up is at least 6 months. The primary endpoint is peak oxygen consumption (VO₂ peak).

Secondary endpoints include measured and self-reported daily physical activity, cardiovascular risk factor control, health-related quality of life, days lost due to (non)cardiovascular rehospitalizations and time to first (non)cardiovascular rehospitalization. A clinical event committee blinded to treatment allocation assesses causes of rehospitalizations. DISCUSSION: Telerehab III will be one of the first studies to examine the added value of a more comprehensive cardiac telerehabilitation program, focusing on multiple cardiac rehabilitation core components. It has the potential to augment current standard center-based cardiac rehabilitation practices and to be used as a model for other disease prevention programs. TRIAL REGISTRATION: Current controlled trials ISRCTN29243064. Registration date 21 January 2015.

Frederix, I., Vanhees, L., Dendale, P., et al. (2015). "A review of telerehabilitation for cardiac patients." *J Telemed Telecare* **21**(1): 45-53.

We conducted a literature review of telerehabilitation interventions on cardiac patients. We searched for studies evaluating some form of telerehabilitation in cardiac patients. A total of 116 publications were screened initially, of which 37 publications were eligible for further review. We assessed study strength, based on the level of evidence and the quality of the intervention. The majority of the articles (70%) represented the highest level of evidence. Most interventions were of good (46%) or fair (51%) quality. Most studies evaluated the efficacy of the telerehabilitation interventions (84%), while 38% reported on feasibility and acceptance. Most studies did not include safety and/or cost-benefit analyses. Most telerehabilitation interventions (90%) employed only one or two core components of cardiac rehabilitation (CR). Of the CR core components, physical activity was most frequently evaluated. Telerehabilitation appears to be a feasible and effective additional and/or alternative form of rehabilitation, compared to conventional in-hospital CR. Evaluations of telerehabilitation programmes taking into account patient safety and health economics are now required.

Gandapur, Y., Kianoush, S., Kelli, H. M., et al. (2016). "The role of mHealth for improving medication adherence in patients with cardiovascular disease: a systematic review." *Eur Heart J Qual Care Clin Outcomes* **2**(4): 237-244.

Cardiovascular disease is a leading cause of morbidity and mortality worldwide, and a key barrier to improved outcomes is medication non-adherence. The aim of this study is to review the role of mobile health (mHealth) tools for improving medication adherence in patients with cardiovascular disease. We performed a systematic search for randomized controlled trials that primarily investigated mHealth tools for improving adherence to cardiovascular disease medications in patients with hypertension, coronary artery disease, heart failure, peripheral arterial disease, and stroke. We extracted and reviewed data on the types of mHealth tools used, preferences of patients and healthcare providers, the effect of the mHealth interventions on medication adherence, and the limitations of trials. We identified 10 completed trials matching our selection criteria, mostly with <100 participants, and ranging in duration from 1 to 18 months. mHealth tools included text messages, Bluetooth-enabled electronic pill boxes, online messaging platforms, and interactive voice calls. Patients and healthcare providers generally preferred mHealth to other interventions. All 10 studies reported that mHealth interventions improved medication adherence, though the magnitude of benefit was not consistently large and in one study was not greater than a telehealth comparator. Limitations of trials included small sample sizes, short duration of follow-up, self-reported outcomes, and insufficient assessment of unintended harms and financial implications. Current evidence suggests that mHealth tools can improve medication adherence in patients with cardiovascular diseases. However, high-quality clinical trials of

sufficient size and duration are needed to move the field forward and justify use in routine care.

Gorst, S. L., Armitage, C. J., Brownsell, S., et al. (2014). "Home telehealth uptake and continued use among heart failure and chronic obstructive pulmonary disease patients: a systematic review." *Ann Behav Med* **48**(3): 323-336.

BACKGROUND: Home telehealth has the potential to benefit heart failure (HF) and chronic obstructive pulmonary disease (COPD) patients, however large-scale deployment is yet to be achieved. **PURPOSE:** The aim of this review was to assess levels of uptake of home telehealth by patients with HF and COPD and the factors that determine whether patients do or do not accept and continue to use telehealth. **METHODS:** This research performs a narrative synthesis of the results from included studies. **RESULTS:** Thirty-seven studies met the inclusion criteria. Studies that reported rates of refusal and/or withdrawal found that almost one third of patients who were offered telehealth refused and one fifth of participants who did accept later abandoned telehealth. Seven barriers to, and nine facilitators of, home telehealth use were identified. **CONCLUSIONS:** Research reports need to provide more details regarding telehealth refusal and abandonment, in order to understand the reasons why patients decide not to use telehealth.

Greenhalgh, T., A'Court, C. et Shaw, S. (2017). "Understanding heart failure; explaining telehealth - a hermeneutic systematic review." *BMC Cardiovasc Disord* **17**(1): 156.

BACKGROUND: Enthusiasts for telehealth extol its potential for supporting heart failure management. But randomised trials have been slow to recruit and produced conflicting findings; real-world roll-out has been slow. We sought to inform policy by making sense of a complex literature on heart failure and its remote management. **METHODS:** Through database searching and citation tracking, we identified 7 systematic reviews of systematic reviews, 32 systematic reviews (including 17 meta-analyses and 8 qualitative reviews); six mega-trials and over 60 additional relevant empirical studies and commentaries. We synthesised these using Boell's hermeneutic methodology for systematic review, which emphasises the quest for understanding. **RESULTS:** Heart failure is a complex and serious condition with frequent co-morbidity and diverse manifestations including severe tiredness. Patients are often frightened, bewildered, socially isolated and variably able to self-manage. Remote monitoring technologies are many and varied; they create new forms of knowledge and new possibilities for care but require fundamental changes to clinical roles and service models and place substantial burdens on patients, carers and staff. The policy innovation of remote biomarker monitoring enabling timely adjustment of medication, mediated by "activated" patients, is based on a modernist vision of efficient, rational, technology-mediated and guideline-driven ("cold") care. It contrasts with relationship-based ("warm") care valued by some clinicians and by patients who are older, sicker and less technically savvy. Limited uptake of telehealth can be analysed in terms of key tensions: between tidy, "textbook" heart failure and the reality of multiple comorbidities; between basic and intensive telehealth; between activated, well-supported patients and vulnerable, unsupported ones; between "cold" and "warm" telehealth; and between fixed and agile care programmes. **CONCLUSION:** The limited adoption of telehealth for heart failure has complex clinical, professional and institutional causes, which are unlikely to be elucidated by adding more randomised trials of technology-on versus technology-off to an already-crowded literature. An alternative approach is proposed, based on naturalistic study designs, application of social and organisational theory, and co-design of new service models based on socio-technical principles. Conventional systematic reviews (whose goal is synthesising

data) can be usefully supplemented by hermeneutic reviews (whose goal is deepening understanding).

Guidi, G., Pollonini, L., Dacso, C. C., et al. (2015). "A multi-layer monitoring system for clinical management of Congestive Heart Failure." *BMC Med Inform Decis Mak* **15 Suppl 3**: S5.

BACKGROUND: Congestive Heart Failure (CHF) is a serious cardiac condition that brings high risks of urgent hospitalization and death. Remote monitoring systems are well-suited to managing patients suffering from CHF, and can reduce deaths and re-hospitalizations, as shown by the literature, including multiple systematic reviews. **METHODS:** The monitoring system proposed in this paper aims at helping CHF stakeholders make appropriate decisions in managing the disease and preventing cardiac events, such as decompensation, which can lead to hospitalization or death. Monitoring activities are stratified into three layers: scheduled visits to a hospital following up on a cardiac event, home monitoring visits by nurses, and patient's self-monitoring performed at home using specialized equipment. Appropriate hardware, desktop and mobile software applications were developed to enable a patient's monitoring by all stakeholders. For the first two layers, we designed and implemented a Decision Support System (DSS) using machine learning (Random Forest algorithm) to predict the number of decompensations per year and to assess the heart failure severity based on a variety of clinical data. For the third layer, custom-designed sensors (the Blue Scale system) for electrocardiogram (EKG), pulse transit times, bio-impedance and weight allowed frequent collection of CHF-related data in the comfort of the patient's home. We also performed a short-term Heart Rate Variability (HRV) analysis on electrocardiograms self-acquired by 15 healthy volunteers and compared the obtained parameters with those of 15 CHF patients from PhysioNet's PhysioBank archives. **RESULTS:** We report numerical performances of the DSS, calculated as multiclass accuracy, sensitivity and specificity in a 10-fold cross-validation. The obtained average accuracies are: 71.9% in predicting the number of decompensations and 81.3% in severity assessment. The most serious class in severity assessment is detected with good sensitivity and specificity (0.87 / 0.95), while, in predicting decompensation, high specificity combined with good sensitivity prevents false alarms. The HRV parameters extracted from the self-measured EKG using the Blue Scale system of sensors are comparable with those reported in the literature about healthy people. **CONCLUSIONS:** The performance of DSSs trained with new patients confirmed the results of previous work, and emphasizes the strong correlation between some CHF markers, such as brain natriuretic peptide (BNP) and ejection fraction (EF), with the outputs of interest. Comparing HRV parameters from healthy volunteers with HRV parameters obtained from PhysioBank archives, we confirm the literature that considers the HRV a promising method for distinguishing healthy from CHF patients.

Hailey, D., Roine, R., Ohinmaa, A., et al. (2011). "Evidence of benefit from telerehabilitation in routine care: a systematic review." *J Telemed Telecare* **17(6)**: 281-287.

We systematically reviewed the evidence on the effectiveness of telerehabilitation (TR) applications. The review included reports on rehabilitation for any disability, other than mental health conditions, and drug or alcohol addiction. All forms of telecommunications technology for TR and all types of study design were considered. Study quality was assessed using an approach that considered both study performance and study design. Judgements were made on whether each TR application had been successful, whether reported outcomes were clinically significant, and whether further data were needed to establish the application as suitable for routine use. Sixty-one scientifically credible studies that reported patient outcomes or administrative changes were identified through computerized literature searches on five databases. Twelve clinical categories were covered by the studies. Those

dealing with cardiac or neurological rehabilitation were the most numerous. Thirty-one of the studies (51%) were of high or good quality. Study results showed that 71% of the TR applications were successful, 18% were unsuccessful and for 11% the status was unclear. The reported outcomes for 51% of the applications appeared to be clinically significant. Poorer-quality studies tended to have worse outcomes than those from high- or good-quality studies. We judged that further study was required for 62% of the TR applications and desirable for 23%. TR shows promise in many fields, but compelling evidence of benefit and of impact on routine rehabilitation programmes is still limited. There is a need for more detailed, better-quality studies and for studies on the use of TR in routine care.

Hamilton, S. J., Mills, B., Birch, E. M., et al. (2018). "Smartphones in the secondary prevention of cardiovascular disease: a systematic review." BMC Cardiovasc Disord **18**(1): 25.

BACKGROUND: Cardiac Rehabilitation (CR) and secondary prevention are effective components of evidence-based management for cardiac patients, resulting in improved clinical and behavioural outcomes. Mobile health (mHealth) is a rapidly growing health delivery method that has the potential to enhance CR and heart failure management. We undertook a systematic review to assess the evidence around mHealth interventions for CR and heart failure management for service and patient outcomes, cost effectiveness with a view to how mHealth could be utilized for rural, remote and Indigenous cardiac patients. **METHODS:** A comprehensive search of databases using key terms was conducted for the years 2000 to August 2016 to identify randomised and non-randomised trials utilizing smartphone functionality and a model of care that included CR and heart failure management. Included studies were assessed for quality and risk of bias and data extraction was undertaken by two independent reviewers. **RESULTS:** Nine studies described a mix of mHealth interventions for CR (5 studies) and heart failure (4 studies) in the following categories: feasibility, utility and uptake studies; and randomised controlled trials. Studies showed that mHealth delivery for CR and heart failure management is feasible with high rates of participant engagement, acceptance, usage, and adherence. Moreover, mHealth delivery of CR was as effective as traditional centre-based CR (TCR) with significant improvement in quality of life. Hospital utilization for heart failure patients showed inconsistent reductions. There was limited inclusion of rural participants. **CONCLUSION:** Mobile health delivery has the potential to improve access to CR and heart failure management for patients unable to attend TCR programs. Feasibility testing of culturally appropriate mHealth delivery for CR and heart failure management is required in rural and remote settings with subsequent implementation and evaluation into local health care services.

Heikkila, A. et Maijala, V. (2016). "Heart failure patients' experiences of mobile phone-based telemonitoring in self-care: a qualitative systematic review protocol." JBI Database System Rev Implement Rep **14**(5): 68-74.

REVIEW QUESTION/OBJECTIVE: The objective of this systematic review is to explore heart failure patients' experiences of mobile-phone based telemonitoring in self-care.

Hughes, H. A. et Granger, B. B. (2014). "Racial disparities and the use of technology for self-management in blacks with heart failure: a literature review." Curr Heart Fail Rep **11**(3): 281-289.

Heart failure is a debilitating illness that requires patients to be actively engaged in self-management. Self-management practices, including maintenance and management of an evidence-based medication regimen, are associated with improved outcomes. Yet, sustained engagement with self-management practices remains a challenge. Both self-management

practices and clinical outcomes differ by race, with the poorest self-management and clinical outcomes reported in Blacks. Contemporary interventions to address self-management and reverse current trends in outcomes have evaluated the use of technology. Technological innovations, such as text messaging, social networking, and online learning platforms may provide a more accessible means for self-management of heart failure, yet these innovations have been understudied in the population at greatest risk - Blacks with heart failure. We conducted a review and discovered only four studies evaluating use of technology for self-management in Blacks. More studies are needed to close the gap on racial disparities and use of technology for self-management.

Hwang, R., Bruning, J., Morris, N., et al. (2015). "A Systematic Review of the Effects of Telerehabilitation in Patients With Cardiopulmonary Diseases." *J Cardiopulm Rehabil Prev* **35**(6): 380-389.

PURPOSE: To examine the effects of telerehabilitation compared with other delivery models for improving physical or functional outcomes in patients with cardiopulmonary diseases. **METHODS:** A search was completed for English language publications from 1990 to August 2013 across 4 electronic databases and gray literature. Inclusion criteria were: (1) home-based telerehabilitation as a core component; (2) at least 2 exercise sessions; (3) randomized controlled trials; and (4) reporting of physical or functional outcome measures in adult patients with coronary heart disease, chronic heart failure, and chronic respiratory disease. Studies were independently screened by 2 reviewers and graded by a reviewer according to the Downs and Black checklist. A narrative synthesis of the included studies was undertaken. **RESULTS:** Eleven studies were analyzed. It appears that telerehabilitation is no different to other delivery models for patients with cardiopulmonary diseases, in terms of exercise capacity expressed as distance on the 6-minute walk test and peak oxygen consumption and quality of life. Telerehabilitation appears to have higher adherence rates compared with center-based exercise. There has been similar or no adverse events reported in telerehabilitation compared with center-based exercise. **CONCLUSIONS:** Although telerehabilitation shows promise in patients with cardiopulmonary diseases, compelling evidence is still limited. There is a need for more detailed, high-quality studies and for studies on the use of video-based telerehabilitation.

Inglis, S. C., Clark, R. A., McAlister, F. A., et al. (2011). "Which components of heart failure programmes are effective? A systematic review and meta-analysis of the outcomes of structured telephone support or telemonitoring as the primary component of chronic heart failure management in 8323 patients: Abridged Cochrane Review." *Eur J Heart Fail* **13**(9): 1028-1040.

AIMS: Telemonitoring (TM) and structured telephone support (STS) have the potential to deliver specialized management to more patients with chronic heart failure (CHF), but their efficacy is still to be proven. The aim of this meta-analysis was to review randomized controlled trials (RCTs) of TM or STS for all-cause mortality and all-cause and CHF-related hospitalizations in patients with CHF, as a non-invasive remote model of a specialized disease-management intervention. **METHODS AND RESULTS:** We searched all relevant electronic databases and search engines, hand-searched bibliographies of relevant studies, systematic reviews, and meeting abstracts. Two reviewers independently extracted all data. Randomized controlled trials comparing TM or STS to usual care in patients with CHF were included. Studies that included intensified management with additional home or clinic-visits were excluded. Primary outcomes (mortality and hospitalizations) were analysed; secondary outcomes (cost, length of stay, and quality of life) were tabulated. Thirty RCTs of STS and TM were identified (25 peer-reviewed publications (n= 8323) and five abstracts (n= 1482)). Of the 25 peer-reviewed studies, 11 evaluated TM (2710 participants), 16 evaluated STS (5613

participants) with two testing both STS and TM in separate intervention arms compared with usual care. Telemonitoring reduced all-cause mortality {risk ratio (RR) 0.66 [95% confidence interval (CI) 0.54-0.81], $P < 0.0001$ } and STS showed a similar, but non-significant trend [RR 0.88 (95% CI 0.76-1.01), $P = 0.08$]. Both TM [RR 0.79 (95% CI 0.67-0.94), $P = 0.008$], and STS [RR 0.77 (95% CI 0.68-0.87), $P < 0.0001$] reduced CHF-related hospitalizations. Both interventions improved quality of life, reduced costs, and were acceptable to patients. Improvements in prescribing, patient-knowledge and self-care, and functional class were observed. CONCLUSION: Telemonitoring and STS both appear effective interventions to improve outcomes in patients with CHF. Systematic Review Number: Cochrane Database of Systematic Reviews. 2008:Issue 3. Art. No.: CD007228. DOI: 10.1002/14651858.CD007228.

Kitsiou, S., Pare, G. et Jaana, M. (2013). "Systematic reviews and meta-analyses of home telemonitoring interventions for patients with chronic diseases: a critical assessment of their methodological quality." *J Med Internet Res* **15**(7): e150.

BACKGROUND: Systematic reviews and meta-analyses of home telemonitoring interventions for patients with chronic diseases have increased over the past decade and become increasingly important to a wide range of clinicians, policy makers, and other health care stakeholders. While a few criticisms about their methodological rigor and synthesis approaches have recently appeared, no formal appraisal of their quality has been conducted yet. OBJECTIVE: The primary aim of this critical review was to evaluate the methodology, quality, and reporting characteristics of prior reviews that have investigated the effects of home telemonitoring interventions in the context of chronic diseases. METHODS: Ovid MEDLINE, the Database of Abstract of Reviews of Effects (DARE), and Health Technology Assessment Database (HTA) of the Cochrane Library were electronically searched to find relevant systematic reviews, published between January 1966 and December 2012. Potential reviews were screened and assessed for inclusion independently by three reviewers. Data pertaining to the methods used were extracted from each included review and examined for accuracy by two reviewers. A validated quality assessment instrument, R-AMSTAR, was used as a framework to guide the assessment process. RESULTS: Twenty-four reviews, nine of which were meta-analyses, were identified from more than 200 citations. The bibliographic search revealed that the number of published reviews has increased substantially over the years in this area and although most reviews focus on studying the effects of home telemonitoring on patients with congestive heart failure, researcher interest has extended to other chronic diseases as well, such as diabetes, hypertension, chronic obstructive pulmonary disease, and asthma. Nevertheless, an important number of these reviews appear to lack optimal scientific rigor due to intrinsic methodological issues. Also, the overall quality of reviews does not appear to have improved over time. While several criteria were met satisfactorily by either all or nearly all reviews, such as the establishment of an a priori design with inclusion and exclusion criteria, use of electronic searches on multiple databases, and reporting of studies characteristics, there were other important areas that needed improvement. Duplicate data extraction, manual searches of highly relevant journals, inclusion of gray and non-English literature, assessment of the methodological quality of included studies and quality of evidence were key methodological procedures that were performed infrequently. Furthermore, certain methodological limitations identified in the synthesis of study results have affected the results and conclusions of some reviews. CONCLUSIONS: Despite the availability of methodological guidelines that can be utilized to guide the proper conduct of systematic reviews and meta-analyses and eliminate potential risks of bias, this knowledge has not yet been fully integrated in the area of home telemonitoring. Further efforts should be made to improve the design, conduct, reporting, and publication of systematic reviews and meta-analyses in this area.

Kitsiou, S., Pare, G. et Jaana, M. (2015). "Effects of home telemonitoring interventions on patients with chronic heart failure: an overview of systematic reviews." *J Med Internet Res* **17**(3): e63.

BACKGROUND: Growing interest on the effects of home telemonitoring on patients with chronic heart failure (HF) has led to a rise in the number of systematic reviews addressing the same or very similar research questions with a concomitant increase in discordant findings. Differences in the scope, methods of analysis, and methodological quality of systematic reviews can cause great confusion and make it difficult for policy makers and clinicians to access and interpret the available evidence and for researchers to know where knowledge gaps in the extant literature exist. **OBJECTIVE:** This overview aims to collect, appraise, and synthesize existing evidence from multiple systematic reviews on the effectiveness of home telemonitoring interventions for patients with chronic heart failure (HF) to inform policy makers, practitioners, and researchers. **METHODS:** A comprehensive literature search was performed on MEDLINE, EMBASE, CINAHL, and the Cochrane Library to identify all relevant, peer-reviewed systematic reviews published between January 1996 and December 2013. Reviews were searched and screened using explicit keywords and inclusion criteria. Standardized forms were used to extract data and the methodological quality of included reviews was appraised using the AMSTAR (assessing methodological quality of systematic reviews) instrument. Summary of findings tables were constructed for all primary outcomes of interest, and quality of evidence was graded by outcome using the GRADE (Grades of Recommendation, Assessment, Development, and Evaluation) system. Post-hoc analysis and subgroup meta-analyses were conducted to gain further insights into the various types of home telemonitoring technologies included in the systematic reviews and the impact of these technologies on clinical outcomes. **RESULTS:** A total of 15 reviews published between 2003 and 2013 were selected for meta-level synthesis. Evidence from high-quality reviews with meta-analysis indicated that taken collectively, home telemonitoring interventions reduce the relative risk of all-cause mortality (0.60 to 0.85) and heart failure-related hospitalizations (0.64 to 0.86) compared with usual care. Absolute risk reductions ranged from 1.4%-6.5% and 3.7%-8.2%, respectively. Improvements in HF-related hospitalizations appeared to be more pronounced in patients with stable HF: hazard ratio (HR) 0.70 (95% credible interval [CrI] 0.34-1.5)]. Risk reductions in mortality and all-cause hospitalizations appeared to be greater in patients who had been recently discharged (\leq 28 days) from an acute care setting after a recent HF exacerbation: HR 0.62 (95% CrI 0.42-0.89) and HR 0.67 (95% CrI 0.42-0.97), respectively. However, quality of evidence for these outcomes ranged from moderate to low suggesting that further research is very likely to have an important impact on our confidence in the observed estimates of effect and may change these estimates. The post-hoc analysis identified five main types of non-invasive telemonitoring technologies included in the systematic reviews: (1) video-consultation, with or without transmission of vital signs, (2) mobile telemonitoring, (3) automated device-based telemonitoring, (4) interactive voice response, and (5) Web-based telemonitoring. Of these, only automated device-based telemonitoring and mobile telemonitoring were effective in reducing the risk of all-cause mortality and HF-related hospitalizations. More research data are required for interactive voice response systems, video-consultation, and Web-based telemonitoring to provide robust conclusions about their effectiveness. **CONCLUSIONS:** Future research should focus on understanding the process by which home telemonitoring works in terms of improving outcomes, identify optimal strategies and the duration of follow-up for which it confers benefits, and further investigate whether there is differential effectiveness between chronic HF patient groups and types of home telemonitoring technologies.

Kraai, I. H., Luttik, M. L., de Jong, R. M., et al. (2011). "Heart failure patients monitored with telemedicine: patient satisfaction, a review of the literature." *J Card Fail* **17**(8): 684-690.

BACKGROUND: Remote monitoring of the clinical status of heart failure patients has developed rapidly and is the subject of several trials. Patient satisfaction is an important outcome, as recommended by the U.S. Food and Drug Administration to use in clinical research, and should be included in studies concerning remote monitoring. The objective of this review is to describe the current state of the literature on patient satisfaction with noninvasive telemedicine, regarding definition, measurement, and overall level of patient satisfaction with telemedicine. **METHODS AND RESULTS:** The Pubmed, Embase, Cochrane, and Cinahl databases were searched using heart failure-, satisfaction-, and telemedicine-related search terms. The literature search identified 193 publications, which were reviewed by 2 independent reviewers. Fourteen articles were included. None of the articles described a clear definition or concept of patient satisfaction with telemedicine. Patient satisfaction with telemedicine was measured with self-developed questionnaires or face-to-face or telephonic interviews. None of the articles used the same questionnaire or telephonic survey to measure patient satisfaction. Only one questionnaire was assessed for validity and reliability. In general, patients seemed to be satisfied or very satisfied with the use of telemedicine. **CONCLUSIONS:** Measurement of patient satisfaction is still underexposed in telemedicine research and the measurement of patient satisfaction with telemedicine underappreciated with poorly constructed questionnaires.

Kruse, C. S., Soma, M., Pulluri, D., et al. (2017). "The effectiveness of telemedicine in the management of chronic heart disease - a systematic review." *JRSM Open* **8**(3): 2054270416681747.

OBJECTIVE: The primary objective of this systematic review is to assess the effectiveness of telemedicine in managing chronic heart disease patients concerning improvement in varied health attributes. **DESIGN:** This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard. **SETTING:** We adopted a logical search process used in two main research databases, the Cumulative Index to Nursing and Allied Health Literature and PubMed (MEDLINE). Four reviewers meticulously screened 151 abstracts to determine relevancy and significance to our research objectives. The final sample in the literature review consisted of 20 articles. **MAIN OUTCOME MEASURES:** We looked for improved medical outcomes as the main outcome measure. **RESULTS:** Our results indicated that telemedicine is highly associated with the reduction in hospitalisations and readmissions (9 of 20 articles, 45%). The other significant attributes most commonly encountered were improved mortality and cost-effectiveness (both 40%) and improved health outcomes (35%). Patient satisfaction occurred the least in the literature, mentioned in only 2 of 20 articles (10%). There was no significant mention of an increase in patient satisfaction because of telemedicine. **CONCLUSIONS:** We concluded that telemedicine is considered to be effective in quality measures such as readmissions, moderately effective in health outcomes, only marginally effective in customer satisfaction. Telemedicine shows promise on an alternative modality of care for cardiovascular disease, but additional exploration should continue to quantify the quality measures.

Kuijpers, W., Groen, W. G., Aaronson, N. K., et al. (2013). "A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: relevance for cancer survivors." *J Med Internet Res* **15**(2): e37.

BACKGROUND: Patient empowerment reflects the ability of patients to positively influence their health and health behavior such as physical activity. While interactive Web-based interventions are increasingly used in various chronic disease settings to enhance empowerment and physical activity, such interventions are still uncommon for cancer survivors. **OBJECTIVE:** The objective of this study was to systematically review the literature

regarding interactive Web-based interventions. We focused on interventions aimed at increasing patient empowerment and physical activity for various chronic conditions, and explored their possible relevance for cancer survivors. METHODS: Searches were performed in PubMed, Embase, and Scopus to identify peer-reviewed papers reporting on randomized controlled trials that studied the effects of Web-based interventions. These interventions were developed for adults with diabetes, cardiovascular disease, chronic obstructive pulmonary disease, heart failure, or cancer. Intervention characteristics, effects on patient empowerment and physical activity, information on barriers to and facilitators of intervention use, users' experiences, and methodological quality were assessed. Results were summarized in a qualitative way. We used the recommendations of the Institute of Medicine (IOM) regarding cancer survivorship care to explore the relevance of the interventions for cancer survivors. RESULTS: We included 19 papers reporting on trials with 18 unique studies. Significant, positive effects on patient empowerment were reported by 4 studies and 2 studies reported positive effects on physical activity. The remaining studies yielded mixed results or no significant group differences in these outcomes (ie, no change or improvement for all groups). Although the content, duration, and frequency of interventions varied considerably across studies, commonly used elements included education, self-monitoring, feedback/tailored information, self-management training, personal exercise program, and communication (eg, chat, email) with either health care providers or patients. Limited information was found on barriers, facilitators, and users' experiences. Methodological quality varied, with 13 studies being of moderate quality. The reported Web-based intervention elements appeared to be highly relevant to address the specific needs of cancer survivors as indicated by the IOM. CONCLUSIONS: We identified 7 common elements of interactive, Web-based interventions in chronic disease settings that could possibly be translated into eHealth recommendations for cancer survivors. While further work is needed to determine optimal intervention characteristics, the work performed in other chronic disease settings provides a basis for the design of an interactive eHealth approach to improve patient empowerment and physical activity in cancer survivors. This may subsequently improve their health status and quality of life and reduce their need for supportive care.

Lin, M. H., Yuan, W. L., Huang, T. C., et al. (2017). "Clinical effectiveness of telemedicine for chronic heart failure: a systematic review and meta-analysis." *J Investig Med* **65**(5): 899-911.

Telemedicine interventions may be associated with reductions in hospital admission rate and mortality in patients with heart failure (HF). The present study is an updated analysis (as of June 30, 2016) of randomized controlled trials, where patients with HF underwent telemedicine care or the usual standard care. Data were extracted from 39 eligible studies for all-cause and HF-related hospital admission rate, length of stay, and mortality. The overall all-cause mortality (pooled OR=0.80, 95% CI 0.71 to 0.91, $p<0.001$), HF-related admission rate (pooled OR=0.63, 95% CI 0.53 to 0.76, $p<0.001$), and HF-related length of stay (pooled standardized difference in means=-0.37, 95% CI -0.72 to -0.02, $p=0.041$) were significantly lower in the telemedicine group (teletransmission and telephone-supported care), as compared with the control group. In subgroup analysis, all-cause mortality (pooled OR=0.69, 95% CI 0.56 to 0.86, $p=0.001$), HF-related admission rate (OR=0.61, 95% CI 0.42 to 0.88, $p=0.008$), HF-related length of stay (pooled standardized difference in means=-0.96, 95% CI -1.88 to -0.05, $p=0.039$) and HF-related mortality (OR=0.68, 95% CI 0.54 to 0.85, $p=0.001$) were significantly lower in the teletransmission group, as opposed to the standard care group, whereas only HF-related admission rate (OR=0.64, 95% CI 0.52 to 0.79, $p<0.001$) was lower in the telephone-supported care group. Overall, telemedicine was shown to be beneficial, with home-based teletransmission effectively reducing all-cause mortality and HF-related hospital admission, length of stay and mortality in patients with HF.

Liu, X. B., Ayatollahi, Y., Yamashita, T., et al. (2019). "Health Literacy and Mortality in Patients With Heart Failure: A Systematic Review and Meta-Analysis." *Res Gerontol Nurs* **12**(2): 99-108.

Heart failure (HF) remains the most common diagnosis of hospital admission among U.S. adults. Although diagnosis and treatment have improved, mortality rates have not changed, and mortality risk remains high after hospitalization. The current researchers examined how limited health literacy is associated with mortality risk in adults with recent hospitalization due to decompensated HF. Researchers conducted a systematic literature search, selecting three cohort and three intervention studies. The fixed-effect model was used. From the three cohort studies, 2,858 study participants were analyzed. Among participants, limited health literacy was associated with higher all-cause mortality (pooled odds ratio = 2.95; 95% confidence interval [2.34, 3.72]; $p < 0.01$; $I(2) = 47.38\%$). However, none of the intervention studies showed an association between limited health literacy and cardiac (or all-cause) mortality. Future research should focus on the efficiency and safety of telehealth-based medicine in patients with HF, particularly those with limited health literacy. [Res Gerontol Nurs. 2019; 12(2):91-108.].

Maeder, A., Poultney, N., Morgan, G., et al. (2015). "Patient Compliance in Home-Based Self-Care Telehealth Projects." *J Telemed Telecare* **21**(8): 439-442.

This paper presents the findings of a literature review on patient compliance in home-based self-care telehealth monitoring situations, intended to establish a knowledge base for this aspect which is often neglected alongside more conventional clinical, economic and service evaluations. A systematic search strategy led to 72 peer-reviewed published scientific papers being selected as most relevant to the topic, 58 of which appeared in the last 10 years. Patient conditions in which most evidence for compliance was found were blood pressure, heart failure and stroke, diabetes, asthma, chronic obstructive pulmonary disease and other respiratory diseases. In general, good compliance at the start of a study was found to drop off over time, most rapidly in the period immediately after the start. Success factors identified in the study included the extent of patient health education, telehealth system implementation style, user training and competence in system usage, active human support from the healthcare provider and maintaining strong participant motivation.

Mohammadzadeh, N., Safdari, R. et Rahimi, A. (2013). "Multi-agent system as a new approach to effective chronic heart failure management: key considerations." *Healthc Inform Res* **19**(3): 162-166.

OBJECTIVES: Given the importance of the follow-up of chronic heart failure (CHF) patients to reduce common causes of re-admission and deterioration of their status that lead to imposing spiritual and physical costs on patients and society, modern technology tools should be used to the best advantage. The aim of this article is to explain key points which should be considered in designing an appropriate multi-agent system to improve CHF management. **METHODS:** In this literature review articles were searched with keywords like multi-agent system, heart failure, chronic disease management in Science Direct, Google Scholar and PubMed databases without regard to the year of publications. **RESULTS:** Agents are an innovation in the field of artificial intelligence. Because agents are capable of solving complex and dynamic health problems, to take full advantage of e-Health, the healthcare system must take steps to make use of this technology. Key factors in CHF management through a multi-agent system approach must be considered such as organization, confidentiality in general aspects and design and architecture points in specific aspects. **CONCLUSIONS:** Note that use of agent systems only with a technical view is associated with many problems. Hence, in delivering healthcare to CHF patients, considering social and

human aspects is essential. It is obvious that identifying and resolving technical and non-technical challenges is vital in the successful implementation of this technology.

Mortara, A., Oliva, F. et Di Lenarda, A. (2010). "[Current perspectives in telemonitoring and devices in chronic heart failure patients: lights and shadows]." *G Ital Cardiol (Rome)* **11**(5 Suppl 2): 33s-37s.

The complexity of an integrated approach, mandatory for chronic diseases such as heart failure, might be simplified by the availability of new technologies for remote data transmission at relatively low costs. Home telemonitoring for complex patients opens new perspectives for the safe discharge of chronically severe patients and intensive surveillance for unstable subjects, and shows potential benefits on patients' quality of life and cost containment. Systematic reviews and meta-analyses document a 30-35% decrease in mortality and a 15-20% reduction in hospital admissions. Critical issues remain the presence of health facilities and professionals both in hospital and in the community adequately prepared for patient management through the telemonitoring tool, the selection of patients who may benefit most from it, and financial reimbursement of remote monitoring. The main indication to telemonitoring is the patient at high risk of short-term hemodynamic deterioration, but psychosocial issues should also be considered. New perspectives for tailored management of heart failure patients come from the recent availability of implantable devices able to record hemodynamic parameters. Current evidence is, however, insufficient to affirm their reliability, efficacy, cost-effectiveness, and management changes that may derive from their use.

Niznik, J. D., He, H. et Kane-Gill, S. L. (2018). "Impact of clinical pharmacist services delivered via telemedicine in the outpatient or ambulatory care setting: A systematic review." *Res Social Adm Pharm* **14**(8): 707-717.

BACKGROUND: Utilization of telemedicine allows pharmacists to extend the reach of clinical interventions, connecting them with patients and providers, but the overall impact of these services is under-studied. **OBJECTIVE:** Identify the impact of clinical pharmacist telemedicine interventions on clinical outcomes, subsequently defined as clinical disease management, patient self-management, and adherence, in outpatient or ambulatory settings. **METHODS:** A literature search was conducted from database inception through May 2016 in Medline, SCOPUS, and EMBASE. Broad terms "telemedicine", "telehealth", and "telephone" were used in combination with "pharmacist" or "pharmacy" and "telepharmacy". The search and extraction process followed PRISMA guidelines. Results were screened for pharmacist interventions and reviewed to identify studies in outpatient or ambulatory settings. Studies of non-clinical outcomes (i.e. dispensing or product preparation) and with no comparator were excluded. The final studies were categorized by types of outcomes reported: clinical disease management, patient self-management, and adherence. **RESULTS:** Only 34 studies measured clinical outcomes against a comparator, consistent with the research question. The majority utilized scheduled models of care (n = 29). Telephone was the most common communication method (n = 25). The most utilized interventions were pharmacist-led telephonic clinics (n = 10). Most studies focused on chronic disease management in adults including hypertension, diabetes, anticoagulation, depression, hyperlipidemia, asthma, heart failure, HIV, PTSD, CKD, stroke, COPD and smoking cessation. Twenty-three studies had a positive impact with one reporting negative results. Higher positive impact rate was observed for scheduled (72.4%, 21/29) and continuous (100%, 2/2) models compared to responsive/reactive (25%, 1/4). **CONCLUSIONS:** Clinical pharmacy telemedicine interventions in the outpatient or ambulatory setting, primarily via phone, have an overall positive impact on outcomes related to clinical disease management, patient self-management, and adherence in the management of chronic diseases. Commonalities among studies with

positive impact included utilization of continuous or scheduled models via telephone, with frequent monitoring and interventions. Studies identified did not evaluate benefits of video capability over telephone or cost-effectiveness, both of which are useful directions for future study.

Pare, G., Moqadem, K., Pineau, G., et al. (2010). "Clinical effects of home telemonitoring in the context of diabetes, asthma, heart failure and hypertension: a systematic review." *J Med Internet Res* **12**(2): e21.

BACKGROUND: Home telemonitoring figures among the various solutions that could help attenuate some of the problems associated with aging populations, rates of chronic illness, and shortages of health professionals. **OBJECTIVE:** The primary aim of this study was to further our understanding of the clinical effects associated with home telemonitoring programs in the context of chronic diseases. **METHODS:** We conducted a systematic review which covered studies published between January 1966 and December 2008. MEDLINE, The Cochrane Library, and the INAHTA (International Network of Agencies for Health Technology Assessment) database were consulted. Our inclusion criteria consisted of: (1) English language publications in peer-reviewed journals or conference proceedings and (2) studies involving patients with diabetes, asthma, heart failure, or hypertension, and presenting results on the clinical effects of home telemonitoring. **RESULTS:** In all, 62 empirical studies were analyzed. The results from studies involving patients with diabetes indicated a trend toward patients with home telemonitoring achieving better glycemic control. In most trials in which patients with asthma were enrolled, results showed significant improvements in patients' peak expiratory flows, significant reductions in the symptoms associated with this illness, and improvements in perceived quality of life. Virtually all studies involving patients with hypertension demonstrated the ability of home telemonitoring to reduce systolic and/or diastolic blood pressure. Lastly, due to the equivocal nature of current findings of home telemonitoring involving patients with heart failure, larger trials are still needed to confirm the clinical effects of this technology for these patients. **CONCLUSIONS:** Although home telemonitoring appears to be a promising approach to patient management, designers of future studies should consider ways to make this technology more effective as well as controlling possible mediating variables.

Pekmezaris, R., Tortez, L., Williams, M., et al. (2018). "Home Telemonitoring In Heart Failure: A Systematic Review And Meta-Analysis." *Health Aff (Millwood)* **37**(12): 1983-1989.

We conducted a meta-analysis of twenty-six randomized controlled trials that tested the effectiveness of home telemonitoring in patients with heart failure for reducing mortality and hospital use. We used the PICOT framework as a tool to address an important variable not previously studied: the timing or duration of monitoring. Specifically, we found that home telemonitoring decreased the odds of all-cause mortality and heart failure-related mortality at 180 days but not at 365 days. Home telemonitoring did not significantly affect the odds of all-cause hospitalization at 90 or 180 days, or of heart failure-related hospitalization at 180 days. At 180 days, home telemonitoring significantly increased the odds of all-cause emergency department visits. Home care provision did not moderate the effects of home telemonitoring on all-cause hospitalization. Recent regulatory changes that relaxed Medicare restrictions on telehealth reimbursement make it imperative that studies fully describe outcomes (for example, heart failure-related versus all-cause hospitalizations) and deliberately test all essential intervention elements, such as intervention duration.

Polisena, J., Tran, K., Cimon, K., et al. (2010). "Home telemonitoring for congestive heart failure: a systematic review and meta-analysis." *J Telemed Telecare* **16**(2): 68-76.

We conducted a systematic review of the literature about home telemonitoring compared with usual care. An electronic literature search was conducted to identify studies of home telemonitoring use in congestive heart failure (CHF) patients. Twenty-one original studies on home telemonitoring for patients with CHF were included (3082 patients). A random effects model was used to compute treatment efficacy to measure the average effect of the intervention across all studies where the quantitative pooling of results was appropriate. Home telemonitoring reduced mortality (risk ratio = 0.64; 95% CI: 0.48-0.85) compared with usual care. Several studies suggested that home telemonitoring also helped to lower the number of hospitalizations and the use of other health services. Patient quality of life and satisfaction with home telemonitoring were similar or better than with usual care. More studies of higher methodological quality are required to give more precise information about the potential clinical effectiveness of home telehealth interventions.

Radhakrishnan, K. et Jacelon, C. (2012). "Impact of telehealth on patient self-management of heart failure: a review of literature." J Cardiovasc Nurs **27**(1): 33-43.

PURPOSE: The objective of the study was to explore the impact of telehealth interventions on individuals' self-care of heart failure (HF). **BACKGROUND:** Heart failure is a chronic illness that requires a complex treatment regimen over a long period. Historically, effective self-care has been difficult for this population. There is a need for innovative and effective approaches to improve individual self-care. Telehealth can potentially help individuals with HF follow the plan of care resulting in improved health outcomes and a better quality of life. **REVIEW METHODS:** A comprehensive computer-assisted literature search using the terms "(telemedicine OR telehealth) AND (self-care OR self-management) AND (heart failure)" was conducted using electronic databases of ASP, CINAHL, Cochrane reviews, ERIC, PubMed, PsychINFO, Social Sciences Abstracts Index, and Web of Science for studies published between 2000 and 2010 to find research that met the inclusion criteria. **RESULTS:** Fourteen studies were included in the review. Telehealth resulted in significant improvement of HF self-care behaviors of daily weighing, medication management, exercise adherence, fluid and alcohol restriction, salt restriction, or stress reduction in the telehealth intervention group in 5 studies. Participants reported improved HF self-care behaviors in 3 other studies with pretest-posttest design. Five others found no difference between the intervention and control groups. Content analysis of the data in the qualitative study revealed themes suggesting that telehealth can be effective in promoting self-care for individuals with HF. However, small sample size and inadequate measurement methods limit the generalizability of the findings of the studies included in this review. **CONCLUSION:** Although this review included several studies with flawed design issues, the available evidence supports the use of telehealth in enabling self-care of HF. Further exploration is needed to determine the effect of telehealth on HF self-care outcomes using studies with high-quality design and improved data collection procedures.

Ruiz-Perez, I., Bastos, A., Serrano-Ripoll, M. J., et al. (2019). "Effectiveness of interventions to improve cardiovascular healthcare in rural areas: a systematic literature review of clinical trials." Prev Med **119**: 132-144.

The objective of this systematic literature review is to examine the impact of interventions to improve cardiovascular disease healthcare provided to people living in rural areas. Systematic electronic searches were conducted in Medline, CINAHL, Embase, Scopus, and Web of Knowledge in July 2018. We included clinical trials assessing the effectiveness of interventions to improve cardiovascular disease healthcare in rural areas. Study eligibility assessment, data extraction, and critical appraisal were undertaken by two reviewers

independently. We identified 18 trials (18 interventions). They targeted myocardial infarction (five interventions), stroke (eight), and heart failure (five). All the interventions for myocardial infarction were based on organizational changes (e.g. implementation of mobile coronary units). They consistently reduced time to treatment and decreased mortality. All the interventions for heart failure were based on the provision of patient education. They consistently improved patient knowledge and self-care behaviour, but mortality reductions were reported in only some of the trials. Among the interventions for stroke, those based on the implementation of telemedicine (tele-stroke systems or tele-consultations) improved monitoring of stroke survivors; those based on new or enhanced rehabilitation services did not consistently improve mortality or physical function; whereas educational interventions effectively improved patient knowledge and behavioural outcomes. In conclusion, a number of different strategies (based on enhancing structures and providing patient education) have been proposed to improve cardiovascular disease healthcare in rural areas. Although available evidence show that these interventions can improve healthcare processes, their impact on mortality and other important health outcomes still remains to be established.

Rush, K. L., Hatt, L., Janke, R., et al. (2018). "The efficacy of telehealth delivered educational approaches for patients with chronic diseases: A systematic review." *Patient Educ Couns* **101**(8): 1310-1321.

OBJECTIVE: The virtual delivery of patient education and other forms of telehealth have been proposed as alternatives to providing needed care for patients with chronic diseases. The purpose of this systematic review was to compare the efficacy of virtual education delivery on patient outcomes compared with usual care. **METHODS:** The review examined citations from 3 databases, MEDLINE, CINAHL, and EMBASE using the search words telehealth, chronic disease, patient education, and related concepts. From 2447 records published between 2006 and 2017, 16 high to moderate quality studies were selected for review. Eligible papers compared virtual education to usual care using designs allowing for assessment of causality. **RESULTS:** Telehealth modalities included the web, telephone, videoconference, and television delivered to patients with diabetes, chronic obstructive pulmonary disease, irritable bowel syndrome and heart failure. In 11 of 16 studies, virtually delivered interventions significantly improved outcomes compared to control conditions. In the remaining 5 studies, virtual education showed comparable outcomes to the control conditions. **CONCLUSIONS:** Findings demonstrated that virtual education delivered to patients with chronic diseases was comparable, or more effective, than usual care. **RESEARCH IMPLICATIONS:** Despite its benefits, there is potential for further research into the individual components which improve effectiveness of virtually delivered interventions.

Stevenson, C. W. et Payne, K. (2017). "Veterans' Voice Through the Lens of Their Medical Records: What It Reveals About Congestive Heart Failure Readmissions." *Prof Case Manag* **22**(1): 21-28.

PURPOSE OF STUDY: The medical record is a sea of information that can reveal what patients are trying to tell us about their health condition. It can reveal hints and trends as to why veterans with congestive heart failure (CHF) are being readmitted within 30 days after hospital discharge. These hints and trends lead caregivers to key contributing variables to veterans' readmission. Furthermore, these variables can be used to predict patient outcomes such as readmission and even prognosis. This article looks at readmissions for CHF from documentation within the medical record to see what was driving the 30-day readmissions. Second, it examines whether the driving forces can be used to predict a veteran's increased risk for readmission or other poor prognosis. **PRIMARY PRACTICE SETTING(S):** The study was conducted at a rural 84-bed Veterans Health Administration hospital in the Western United States. **METHODOLOGY AND SAMPLE:** A retrospective screen was performed on 1,279

veterans' admissions of which 217 were identified as having CHF as a primary or secondary diagnosis on admission. The descriptive statistics, odds ratio (OR) and multivariate logistic regression were used to examine the data. The multivariate logistic regression equation was $p = 1/1 + e$, which can be found in the biostatistics textbook by . developed and validated the equation and used it to screen for undiagnosed diabetic patients. The equation was refined by . The variables selected for this study were based on a literature review of 30 articles.

RESULTS: The probability and OR for 30-day readmissions for all ages increased as the age increased. The ORs for 30-day readmissions for the variables selected were as follows: brain natriuretic peptide 6.21 (95% CI [0.36, 108.24]), ejection fraction 1.298 (95% CI [0.68, 2.49]), hypertension 1.795 (95% CI [0.83, 3.85]), comorbid conditions 1.02 (95% CI [0.04, 25.02]), Stage III and below were protective, Stage IV 2.057 (95% CI [0.63, 9.32]), lack of discharge education 0.446 (95% CI [0.19, 6.45]). The impact of these variables on veterans with more than 3 readmissions (N = 66) was examined. In 32% of these admissions, there was insufficient data to compare the values of the variables between readmissions. In almost 26% (N = 17) of the cases as the number of variables increased, the time between admissions decreased. In 23% of the cases (N = 15), the values did not change; of these, 14 died and the one who survived had assistance with his care in the form of home health and telehealth.

IMPLICATIONS FOR CASE MANAGEMENT PRACTICE: Use of this evidence-based tool will help case managers to strategically plan care and prioritize interventions to impact the major variables and risk factors that are impacting veterans' health.

Walker, R. C., Tong, A., Howard, K., et al. (2019). "Patient expectations and experiences of remote monitoring for chronic diseases: Systematic review and thematic synthesis of qualitative studies." Int J Med Inform **124**: 78-85.

OBJECTIVES: To describe the range of patients' beliefs, attitudes, expectations, and experiences of remote monitoring for chronic conditions across different healthcare contexts and populations. **DESIGN:** We searched MEDLINE, Embase, PsychINFO, and CINAHL, Google Scholar, and reference lists of related studies through to July 2017. Thematic synthesis was used to analyse the findings of the primary studies. Study characteristics were examined to explain differences in findings. **SETTING:** All healthcare settings **PARTICIPANTS:** Adults with chronic diseases **OUTCOMES:** Patient beliefs, attitudes, expectations and experiences of remote monitoring **RESULTS:** We included 16 studies involving 307 participants with chronic obstructive pulmonary disease, heart failure, diabetes, hypertension, and end stage kidney disease. The studies were conducted in 8 countries. We identified four themes: gaining knowledge and triggering actions (tracking and responding to change, prompting timely and accessible care, supporting self-management and shared decision-making); reassurance and security (safety in being alone, peace of mind); concern about additional burden (reluctance to learn something new, lack of trust in technology, avoiding additional out-of-pocket costs), and jeopardising interpersonal connections (fear of being lost in data, losing face to face contact). **CONCLUSIONS:** For patients with chronic disease, remote monitoring increased their disease-specific knowledge, triggered earlier clinical assessment and treatment, improved self-management and shared decision-making. However, these potential benefits were balanced against concerns about losing interpersonal contact, and the additional personal responsibility of remote monitoring.

Wise, J. (2012). "Cochrane review says telephone follow-up of heart failure patients is effective." Bmj **345**: e6187.

Woo, K. et Dowding, D. (2018). "Factors Affecting the Acceptance of Telehealth Services by Heart Failure Patients: An Integrative Review." Telemed J E Health **24**(4): 292-300.

BACKGROUND: While telehealth has been shown to improve heart failure patients' health outcomes, patients' acceptance of telehealth at the point of referral is reported to be low. Little is known about the factors related to patients' initial acceptance or refusal of telehealth services. The aim of this review was to synthesize evidence on the factors affecting heart failure patients' decision making to accept telehealth services in a home setting. **METHODS:** An integrative literature review was conducted. Six electronic databases and three grey literature sites were searched. Two reviewers independently reviewed articles for inclusion. Articles were included if they reported original data related to the acceptance of telehealth services among heart failure patients at home. **RESULTS:** Five studies met the inclusion criteria and were included in the review. Key findings indicated that patients generally hold positive views about telehealth. Factors that may affect the adoption of telehealth include concerns over equipment or technology, concerns over service change, ease-of-use, knowledge of the benefits of telehealth, access to care, cost, and privacy. **CONCLUSIONS:** Despite evidence of effectiveness for telehealth, there is a high rate of telehealth refusal among patients. Understanding factors associated with heart failure patients' decisions regarding telehealth can help healthcare organizations structure education programs and other interventions to improve acceptance rates.

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Yun, J. E., Park, J. E., Park, H. Y., et al. (2018). "Comparative Effectiveness of Telemonitoring Versus Usual Care for Heart Failure: A Systematic Review and Meta-analysis." *J Card Fail* **24**(1): 19-28.

BACKGROUND: This study aimed to evaluate the effectiveness of telemonitoring (TM) in the management of patients with heart failure (HF). **METHODS AND RESULTS:** We searched Ovid-Medline, Ovid-Embase, and the Cochrane Library for randomized controlled trials published through May 2016. Outcomes of interest included clinical effectiveness (mortality, hospitalization, and emergency department visits) and patient-reported outcomes. TM was defined as the transmission of individual biologic data, such as weight, blood pressure, and heart rate. Thirty-seven randomized controlled trials (9582 patients) of TM met the inclusion criteria: 24 studies on all-cause mortality, 17 studies on all-cause hospitalization, 12 studies on HF-related hospitalization, and 5 studies on HF-related mortality. The risks of all-cause

mortality (risk ratio [RR] 0.81, 95% confidence interval [CI] 0.70-0.94) and HF-related mortality (RR 0.68, 95% CI 0.50-0.91) were significantly lower in the TM group than in the usual care group. TM showed a significant benefit when ≥ 3 biologic data are transmitted or when transmission occurred daily. TM also reduced mortality risk in studies that monitored patients' symptoms, medication adherence, or prescription changes. CONCLUSIONS: TM intervention reduces the mortality risk in patients with HF, and intensive monitoring with more frequent transmissions of patient data increases its effectiveness.

LES ETUDES FRANÇAISES

Andres, E., Talha, S., Benyahia, A., et al. (2016). "[Experimentation of an e-platform to detect situations at risk of cardiac impairment (platform E-care) in an internal medicine unit]." *Rev Med Interne* **37**(9): 587-593.

INTRODUCTION: Monitoring patients with heart failure by telemedicine systems is a potential means susceptible to optimize the management of these patients and avoid life-threatening emergencies. In this context, we experimented in internal medicine unit an e-platform E-care dedicated to automated, intelligent detection of situations at risk of heart failure. METHODS: The E-care platform based on medical sensors (blood pressure, heart rate, O₂, weight), communicating (Bluetooth), to go up, in real time, to an intelligent physiological information and an analysis of the ontology medical, leading ultimately to the generation of alerts. After a development phase (proof of concept), the E-care platform has been deployed and tested by health professionals and patients in an internal medicine unit with 20 beds, opened on emergencies to the Strasbourg University Hospitals. RESULTS: One hundred and eighty patients were included and 1500 measurements were obtained. The patient profile included in this experiment was an elderly patient, with comorbidity in 90% of cases, with a loss of autonomy in 25%. Health professionals were using E-care platform every day to their great satisfaction. This experiment made it possible to validate the technology choices, to consolidate the system, and to test the robustness of the platform E-care. The collection continuously allowed us to have the critical number of patients for more detailed analysis of the relevance of alerts related to heart impairment. A preliminary analysis showed the relevance of the generated alerts. CONCLUSION: Preliminary results following the deployment of E-care platform in hospitals appear to show the relevance of technological choices, tools and solutions developed and adopted. This telemedicine system allows automatic, non-intrusive, generate alerts related to the detection of situations at risk for heart failure. Ultimately, E-care was capable of preventing hospitalization. A home deployment is currently underway.

Andres, E., Talha, S., Hajjam, M., et al. (2018). "Experimentation of 2.0 telemedicine in elderly patients with chronic heart failure: A study prospective in 175 patients." *Eur J Intern Med* **51**: e11-e12.

Andres, E., Talha, S., Zulfiqar, A. A., et al. (2018). "Current Research and New Perspectives of Telemedicine in Chronic Heart Failure: Narrative Review and Points of Interest for the Clinician." *J Clin Med* **7**(12).

BACKGROUND: This is a narrative review of both the literature and Internet pertaining to telemedicine projects within the field of heart failure, with special attention placed on remote monitoring of second-generation projects and trials, particularly in France. RESULTS: Since the beginning of the 2000's, several telemedicine projects and trials focused on chronic heart failure have been developed. The first telemedicine projects (e.g., TEN-HMS, BEAT-HF,

Tele-HF, and TIM-HF) primarily investigated telemonitoring or for the older ones, telephone follow-up. Numerous second-generation telemedicine projects have emerged in Europe over the last ten years or are still under development for computer science heart failure, especially in Europe, such as SCAD, OSICAT, E-care, PRADO-INCADO, and TIM-HF2. The E-care telemonitoring project fits within the telemedicine 2.0 framework, based on connected objects, new information and communication technologies (ICT) and Web 2.0 technologies. E-care is the first telemedicine project including artificial intelligence (AI). TIM-HF2 is the first positive prospective randomized study with regards to EBM with positive significant clinical benefit, in terms of unplanned cardiovascular hospital admissions and all-cause deaths. The potential contribution of second-generation telemedicine projects in terms of mortality, morbidity, and number of hospitalizations avoided is currently under study. Their impact in terms of health economics is likewise being investigated, taking into account that the economic and social benefits brought up by telemedicine solutions were previously validated by the original telemedicine projects.

Andres, E., Zulfiqar, A. A., Talha, S., et al. (2018). "Telemedicine in elderly patients with heart failure." Geriatr Psychol Neuropsychiatr Vieil **16**(4): 341-348.

Here, we carry out a review of the literature focused on telemedicine projects developed in the field of heart failure. We will particularly detail the remote monitoring project called E-care, dedicated to automated, intelligent detection of situations at risk of heart failure. Prospects for the development of the E-care system in the field of geriatrics will also be discussed. Results: Numerous telemedicine projects, based on connected objects or technology sciences of information and communication, have emerged in the last five years or are under development in the field of computer science heart failure. This is the case of the E-care telemonitoring project, which fits perfectly within the framework of telemedicine 2.0 projects. Their potential contribution in terms of mortality or morbidity, in number of hospitalizations avoided is currently under study or documentation. Their impact in terms of health economics is also being validated, knowing that the oldest telemedicine projects had already validated the economic and social benefits brought by telemedicine solutions.

Boiteux, M.-C. (2017). "Cardiauvergne : Suivi et coordination de l'insuffisance cardiaque par télémédecine." Revue Hospitaliere De France(575): 20-24, tabl.

[BDSP. Notice produite par EHESP HHH7R0xn. Diffusion soumise à autorisation]. Après 65 ans, l'insuffisance cardiaque chronique représente, toutes pathologies confondues, la première cause d'hospitalisation en France. Pourquoi cette incidence et prévalence en forte croissance ? Le vieillissement de la population ainsi que les progrès obtenus dans le traitement des événements coronaires aigus graves l'expliquent. Le groupement de coopération sanitaire Cardiauvergne assure depuis 2011 le suivi et la coordination de l'insuffisance cardiaque par télémédecine. Avec plus de 1 200 patients déjà inclus, ce dispositif ville-hôpital s'appuie sur l'ensemble des professionnels de santé de proximité. Une étude médico-économique montre son efficacité. (R.A.).

Boiteux, M. C., Rey, P., Cadiou, F., et al. (2016). "[Cardiauvergne is a remote monitoring and care coordination service for patients with severe heart failure]." Soins **61**(810): 45-47.

Since 2011, thanks to the cooperation of frontline healthcare professionals, it has provided care to more than 1 200 patients across the Auvergne health region. The organisation, blending telemedicine and human contact, has made this initiative a successful example of how the boundaries between community and hospital healthcare can be removed.

Boriani, G., Da Costa, A., Quesada, A., et al. (2017). "Effects of remote monitoring on clinical outcomes and use of healthcare resources in heart failure patients with biventricular defibrillators: results of the MORE-CARE multicentre randomized controlled trial." *Eur J Heart Fail* **19**(3): 416-425.

AIMS: The aim of this study was to evaluate the clinical efficacy and safety of remote monitoring in patients with heart failure implanted with a biventricular defibrillator (CRT-D) with advanced diagnostics. **METHODS AND RESULTS:** The MORE-CARE trial is an international, prospective, multicentre, randomized controlled trial. Within 8 weeks of de novo implant of a CRT-D, patients were randomized to undergo remote checks alternating with in-office follow-ups (Remote arm) or in-office follow-ups alone (Standard arm). The primary endpoint was a composite of death and cardiovascular (CV) and device-related hospitalization. Use of healthcare resources was also evaluated. A total of 865 eligible patients (mean age 66 +/- 10 years) were included in the final analysis (437 in the Remote arm and 428 in the Standard arm) and followed for a median of 24 (interquartile range = 15-26) months. No significant difference was found in the primary endpoint between the Remote and Standard arms [hazard ratio 1.02, 95% confidence interval (CI) 0.80-1.30, P = 0.89] or in the individual components of the primary endpoint (P > 0.05). For the composite endpoint of healthcare resource utilization (i.e. 2-year rates of CV hospitalizations, CV emergency department admissions, and CV in-office follow-ups), a significant 38% reduction was found in the Remote vs. Standard arm (incidence rate ratio 0.62, 95% CI 0.58-0.66, P < 0.001) mainly driven by a reduction of in-office visits. **CONCLUSIONS:** In heart failure patients implanted with a CRT-D, remote monitoring did not reduce mortality or risk of CV or device-related hospitalization. Use of healthcare resources was significantly reduced as a result of a marked reduction of in-office visits without compromising patient safety. **TRIAL REGISTRATION:** NCT00885677.

Bourgueil, Y., Picard, F., Dos Santos, P., et al. (2010). "Dossier Insuffisance cardiaque. Une "épidémie" contrôlable ?" *Concours Medical* **132**(6): 231-247, fig., tabl.

[BDSP. Notice produite par ORSRA 9R0xBEB9. Diffusion soumise à autorisation].

L'insuffisance cardiaque, dont la prévalence et l'incidence augmentent, liées à l'âge et aux comorbidités, représente un problème de santé publique à évolution épidémique. Ce dossier aborde le coût de la maladie, sa prévalence en France, la prise en charge par les réseaux ville-hôpital, le télémonitoring, le diagnostic de l'insuffisance cardiaque, le parcours thérapeutique et le suivi des patients par les professionnels de santé (cardiologue, généraliste et infirmière).

Farnia, T., Jaulent, M. C. et Steichen, O. (2018). "Evaluation Criteria of Noninvasive Telemonitoring for Patients With Heart Failure: Systematic Review." *J Med Internet Res* **20**(1): e16.

BACKGROUND: Telemonitoring can improve heart failure (HF) management, but there is no standardized evaluation framework to comprehensively evaluate its impact. **OBJECTIVE:** Our objectives were to list the criteria used in published evaluations of noninvasive HF telemonitoring projects, describe how they are used in the evaluation studies, and organize them into a consistent scheme. **METHODS:** Articles published from January 1990 to August 2015 were obtained through MEDLINE, Web of Science, and EMBASE. Articles were eligible if they were original reports of a noninvasive HF telemonitoring evaluation study in the English language. Studies of implantable telemonitoring devices were excluded. Each selected article was screened to extract the description of the telemonitoring project and the evaluation process and criteria. A qualitative synthesis was performed. **RESULTS:** We identified and reviewed 128 articles leading to 52 evaluation criteria classified into 6 dimensions: clinical, economic, user perspective, educational, organizational, and technical. The clinical and

economic impacts were evaluated in more than 70% of studies, whereas the educational, organizational, and technical impacts were studied in fewer than 15%. User perspective was the most frequently covered dimension in the development phase of telemonitoring projects, whereas clinical and economic impacts were the focus of later phases.

CONCLUSIONS: Telemonitoring evaluation frameworks should cover all 6 dimensions appropriately distributed along the telemonitoring project lifecycle. Our next goal is to build such a comprehensive evaluation framework for telemonitoring and test it on an ongoing noninvasive HF telemonitoring project.

Guedon-Moreau, L., Finat, L., Boule, S., et al. (2015). "Validation of an Organizational Management Model of Remote Implantable Cardioverter-Defibrillator Monitoring Alerts." *Circ Cardiovasc Qual Outcomes* **8**(4): 403-412.

BACKGROUND: Implantable cardioverter-defibrillators (ICDs) are a standard means of sudden cardiac death prevention. Compared with ambulatory visits, remote monitoring (RM) of ICD recipients has improved the quality of health care and spared its resources. Few studies have addressed the organization of RM. We optimized and validated our institutional model of RM organization for ICD recipients. METHODS AND RESULTS: This observational study of 562 ICD recipients compared 2 RM periods consisting of iterative, qualitative, and quantitative (1) device diagnostic evaluations by nurses and cardiologists; and (2) selected decisional trees. The main study end points were the professional interventions prompted by, and times allocated to, RM alerts. During the first period, 1134 alerts occurred in 427 patients (286 patient-year), of which 376 (33%) were submitted to cardiologists' reviews, compared with, 1522 alerts in 562 patients (458 patient-year), of which 273 (18%) were submitted to cardiologists' reviews during the second period ($P < 0.001$). An intervention was prompted by 73 of 376 (19.4%) alerts in the first versus 77 of 273 (28.2%) in the second period ($P = 0.009$). The mean time to manage an alert was 4 minutes 31 s in the first versus 2 minutes 10 s in the second period ($P < 0.001$). The annual numbers of alert-related hospitalizations were 10.8 versus 8.1 per 100-patient-year ($P = 0.230$), and annual numbers of alert-related visits were 9.8 and 6.1 per 100-patient-year ($P = 0.081$), respectively. CONCLUSIONS: An optimized RM organization based on automated alerts and decisional trees enabled a focus on clinically relevant events and a decrease in the consumption of resources without compromising the quality of ICD recipients' care.

Halimi, F. et Cantu, F. (2010). "Remote monitoring for active cardiovascular implantable electronic devices: a European survey." *Europace* **12**(12): 1778-1780.

This survey sampled today's European practices in the use of remote monitoring (RM) for the follow-up of active cardiovascular implantable electronic devices. Eighty-five per cent of the responding centres are currently using RM. For the majority, RM is expected to increase importantly within 5 years, and it has already led to a new organization of care based on dedicated allied professionals and/or the creation of RM units. There are still major limitations for the development of RM, such as ethical and legal aspects, reimbursement issues, and the lack of specific national- and European-updated guidelines which need to be informed.

Lamothe, L., Paquette, M. A., Fortin, J. P., et al. (2013). "[Using telemedicine to improve chronic disease monitoring]." *Sante Publique* **25**(2): 203-211.

AIM: The purpose of this study was to understand how home telecare technologies can be used to improve services for people with chronic diseases. METHODS: Canadian elders with at least one of the targeted chronic diseases (COPD, heart failure, hypertension, diabetes)

were asked to use telehomecare equipment. The data needed to assess the implementation process and to monitor outcomes were collected through participatory observation, documentary analysis and interviews. RESULTS: The study found that the technology has a number of benefits for patients, particularly in terms of access to health services. By enabling patients to access more information about their health, the use of the technology, combined with an educational program, contributes to increasing their capacity for self-management. The results also indicate that the telehomecare equipment had a positive impact on clinical decision-making. By facilitating health professionals' access to information and expertise, it was found to promote interprofessional practice. The study found that telehomecare technology has an organizational impact on practice and requires organizational adaptation, the form of which will depend on local organizational and clinical settings. CONCLUSION: The results suggest that telehomecare technology helps to create conditions that need to be met by health care organizations in order to improve service delivery to people with chronic diseases, particularly with regard to interprofessional collaboration, health professionals' access to information and expertise and active patient participation. However, the successful implementation of the technology requires a detailed analysis of the settings in which it is used.

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