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eHealth interventions for people with chronic kidney disease (Review)

Stevenson JK, Campbell ZC, Webster AC, Chow CK, Tong A, Craig JC, Campbell KL, Lee VWS

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[Intervention Review]

eHealth interventions for people with chronic kidney disease

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ABSTRACT

Background

Chronic kidney disease (CKD) is associated with high morbidity and death, which increases as CKD progresses to end-stage kidney disease (ESKD). There has been increasing interest in developing innovative, effective and cost-efficient methods to engage with patient populations and improve health behaviours and outcomes. Worldwide there has been a tremendous increase in the use of technologies, with increasing interest in using eHealth interventions to improve patient access to relevant health information, enhance the quality of healthcare and encourage the adoption of healthy behaviours.

Objectives

This review aims to evaluate the benefits and harms of using eHealth interventions to change health behaviours in people with CKD.

Search methods

We searched the Cochrane Kidney and Transplant Register of Studies up to 14 January 2019 through contact with the Information Specialist using search terms relevant to this review. Studies in the Register are identified through searches of CENTRAL, MEDLINE, and EMBASE, conference proceedings, the International Clinical Trials Register (ICTRP) Search Portal and ClinicalTrials.gov.

Selection criteria

Randomised controlled trials (RCTs) and quasi-RCTs using an eHealth intervention to promote behaviour change in people with CKD were included. There were no restrictions on outcomes, language or publication type.

Data collection and analysis

Two authors independently assessed trial eligibility, extracted data and assessed the risk of bias. The certainty of the evidence was assessed using GRADE.

Main results

We included 43 studies with 6617 participants that evaluated the impact of an eHealth intervention in people with CKD. Included studies were heterogeneous in terms of eHealth modalities employed, type of intervention, CKD population studied and outcomes assessed. The majority of studies (39 studies) were conducted in an adult population, with 16 studies (37%) conducted in those on dialysis, 11 studies (26%) in the pre-dialysis population, 15 studies (35%) in transplant recipients and 1 studies (2%) in transplant candidates We identified six different eHealth modalities including: Telehealth; mobile or tablet application; text or email messages; electronic monitors; internet/websites; and video or DVD. Three studies used a combination of eHealth interventions. Interventions were categorised into six types: educational; reminder systems; self-monitoring; behavioural counselling; clinical decision-aid; and mixed intervention types. We identified 98 outcomes, which were categorised into nine domains: blood pressure (9 studies); biochemical parameters (6 studies); clinical endpoints (16 studies); dietary intake (3 studies); quality of life (9 studies); medication adherence (10 studies); behaviour (7 studies); physical activity (1 study); and cost-effectiveness (7 studies).

Only three outcomes could be meta-analysed as there was substantial heterogeneity with respect to study population and eHealth modalities utilised. There was found to be a reduction in interdialytic weight gain of 0.13kg (4 studies, 335 participants: MD -0.13, 95% CI -0.28 to 0.01; I^2 = 0%) and a reduction in dietary sodium intake of 197 mg/day (2 studies, 181 participants: MD -197, 95% CI -540.7 to 146.8; I^2 = 0%). Both dietary sodium and fluid management outcomes were graded as being of low evidence due to high or unclear risk of bias and indirectness (interdialytic weight gain) and high or unclear risk of bias and imprecision (dietary sodium intake). Three studies reported death (2799 participants, 146 events), with 45 deaths/1000 cases compared to standard care of 61 deaths/1000 cases (RR 0.74, CI 0.53 to 1.03; P = 0.08). We are uncertain whether using eHealth interventions, in addition to usual care, impact on the number of deaths as the certainty of this evidence was graded as low due to high or unclear risk of bias, indirectness and imprecision.

Authors' conclusions

eHealth interventions may improve the management of dietary sodium intake and fluid management. However, overall these data suggest that current evidence for the use of eHealth interventions in the CKD population is of low quality, with uncertain effects due to methodological limitations and heterogeneity of eHealth modalities and intervention types. Our review has highlighted the need for robust, high quality research that reports a core (minimum) data set to enable meaningful evaluation of the literature.

PLAIN LANGUAGE SUMMARY

eHealth interventions for people with chronic kidney disease

What is the issue?

Chronic kidney disease (CKD) is a condition where kidneys have reduced function over a period of time. To remain well people with CKD need to follow complex diet, lifestyle and medication advice and often need to use several specialist medical services. Some people with advanced CKD may need dialysis or treatment with a kidney transplant. Enabling patients to manage this condition by themselves improves quality and length of life and reduces healthcare costs. Electronic health (eHealth) interventions may improve patients' ability to look after themselves and improve care provided by healthcare services. eHealth interventions refer to "health services and information delivered or enhanced through the Internet and related technologies". However, there is little research evaluating the impact of eHealth interventions in CKD.

What did we do?

We focused on randomised controlled trials (RCT), which enrolled people with CKD (including pre-dialysis, dialysis or kidney transplant), and compared eHealth interventions to usual care.

What did we find?

We found 43 studies involving 6617 people who had CKD that examined if eHealth interventions improve patient care and health outcomes. eHealth interventions used different modes of technology, such as Telehealth, electronic monitors, mobile or tablet applications, text message or emails, websites, and DVDs or videos. Interventions were classified by their intention: educational, reminder systems, self-monitoring, behavioural counselling, clinical decision-aids and mixed interventions. We categorised outcomes into nine domains: dietary intake, quality of life, blood pressure control, medication adherence, results of blood tests, cost-analysis, behaviour, physical activity and clinical end-points such as death. We found that it was uncertain whether using an eHealth interventions improved clinical and patient-centred outcomes compared with usual care. The quality of the included studies was low, meaning we could not be sure that future studies would find similar results.

Conclusions

We are uncertain whether using eHealth interventions improves outcomes for people with CKD. We need large and good quality research studies to help understand the impact of eHealth on the health of people with CKD.

Summary of findings for the main comparison. EHealth interventions compared to standard care in chronic kidney disease populations

EHealth interventions compared to standard care in chronic kidney disease populations

Patient or population: chronic kidney disease populations
Setting:
Intervention: eHealth interventions
Comparison: standard care

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)
	Risk with standard care	Risk with eHealth interventions			
Mortality follow up: mean 12 months	Study population		RR 0.74 (0.53 to 1.03)	2906 (3 RCTs) [4]	⊕⊖⊖⊖ VERY LOW [1 2 3]
	61 per 1,000	45 per 1,000 (32 to 62)			
Interdialytic weight gain follow up: range 6 weeks to 16 weeks		MD 0.13 lower (0.27 lower to 0.01 higher)	-	335 (4 RCTs) [5]	⊕⊕⊖⊖ LOW [1 2]
Dietary sodium intake follow up: mean 4 months		MD 197 mg lower (540.7 lower to 146.8 higher)	-	181 (2 RCTs) [6]	⊕⊕⊖⊖ LOW [1 3]

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **RR:** Risk ratio; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High certainty: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect
Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

[1] Downgraded one level for uncertain or high risk of bias (allocation, blinding, outcome reporting, other biases)

[2] Downgraded one level for inconsistency (different eHealth interventions used, different study lengths)
[3] Downgraded one level for imprecision (small sample size or small number of events, confidence intervals overlap)
[4] Behavioural counselling intervention (Ishani 2016), Clinical Decision Aid (Cooney 2015), Self-monitoring and Education (Navaneethan 2017)
[5] Behavioural counselling intervention (BalanceWise-HD 2013), Self-monitoring intervention (Schulz 2007, Welch 2013, Williams 2017)
[6] Behavioural counselling intervention (BalanceWise-HD 2013), Self-monitoring intervention (Koprucki 2010)

BACKGROUND

Description of the condition

Chronic Kidney Disease (CKD) is associated with high morbidity and death, which increases as CKD progresses to end-stage kidney disease (ESKD). Complications of CKD include cardiovascular disease, premature death, cancer, cognitive decline, anaemia, bone and mineral disorders and bone fractures, and hospitalisation, all associated with high health care usage (Stevens 2013; Jha 2013). Enhancing patient engagement and self-management are the cornerstones of optimal chronic disease management (Tong 2007). Self-management programs can improve patient knowledge, health-related quality of life, delay the need for dialysis, improve clinical outcomes (e.g. blood pressure), improve treatment adherence and improve survival (Bonner 2014; Chen 2011; Devins 2005). The prevention of CKD, and delaying its progression to ESKD, requires complex care because it involves both specific CKD management, as well as management of other prevalent co-morbidities (Lopez-Vargas 2014). Interventions should focus on effective, cost-efficient methods to improve modifiable risk factors such as weight, blood glucose control, blood pressure (BP) control and poor dietary intake that can improve morbidity and death (Couser 2011).

Description of the intervention

With rates of CKD and renal replacement therapy rising, there is a need to find innovative and efficient ways to engage with people with CKD and improve health behaviours and outcomes. Worldwide there is a tremendous increase in the use of technologies with up to 94% of people in developed countries accessing the internet or owning a smartphone (Pew Research Center 2016). In healthcare there is increasing interest in utilising technology-based interventions, commonly referred to as eHealth, to improve patient engagement and enhance care. eHealth refers to "health services and information delivered or enhanced through the Internet and related technologies" (Eysenbach 2001), with these interventions being used to replace standard care or used as an adjunct to standard care. There is a variety of different eHealth modalities reported in the literature, including: Telehealth, mobile phone (including text messaging and the use of applications on mobile phones), internet and computer, electronic monitors and wireless and Bluetooth enabled devices. Within these eHealth interventions there is wide use of these tools, which are categorised as patient self-management interventions or clinician decision support tools.

With more people using technology, the development, adoption and implementation of eHealth holds tremendous promise to improve consumer access to relevant health information, enhance the quality of care and encourage the adoption of healthy behaviours. However, there is currently no published systematic review of data regarding the optimal type, intensity and duration of eHealth strategies to most effectively elicit knowledge and behaviour change. Additionally, there is currently no systematic review of data regarding the impact of eHealth interventions to improve patient-centred and clinical outcomes in the CKD population.

How the intervention might work

There are promising outcomes of using eHealth interventions, when used in addition to traditional counselling techniques, for improving disease management in chronic disease populations. Systematic reviews evaluating the impact of various eHealth interventions compared to standard care report similar or improved results regarding glycaemic control (Kitsiou 2017), CVD clinical outcomes (e.g. hospitalisations, myocardial infarction, stroke) and CVD risk factors (e.g. body mass index, blood pressure, cholesterol) (Widmer 2015), weight loss maintenance (Sorgente 2017), dietary intake (Cotter 2014; Kelly 2016) and exercise behaviours (Cotter 2014). However, to date poor study methodologies and insufficient reporting limit the determination of mechanisms that have prompted behaviour change and resulted in the success or failure of interventions. (Kitsiou 2017; Widmer 2015). Further research is needed to ascertain the most effective eHealth intervention/s to promote behaviour change in different contexts and diseases. In addition, evaluation of the level of consumer personalisation, frequency of interaction and duration (e.g. number of weeks, months or years) of interventions is needed. Similar to traditional interventions (e.g. in-person counselling, paper-based education), eHealth interventions that are designed with a theoretical basis incorporating content that is adaptive to individuals' needs and utilises interactive components such as self-monitoring, personalised feedback, bidirectional communication and group or peer support may result in better clinical and patient-centred outcomes (Cotter 2014; Kitsiou 2017; Widmer 2015). To date economic evaluations of eHealth interventions has been sparse and highlights an important area for further research (Kitsiou 2017; Sanyal 2018).

The use of eHealth interventions in chronic diseases, such as diabetes and CVD, have shown eHealth interventions can improve or provide similar outcomes to traditional interventions (Kitsiou 2017; Widmer 2015). Given the current literature showing positive trends for the use of eHealth in chronic disease management and health behaviour change, it is foreseeable that the CKD population will benefit from the use of eHealth interventions and further review of the literature in CKD is warranted.

Why it is important to do this review

It is important to conduct this review, as strategies for improving patient engagement and enhancing outcomes are vital to reduce morbidity and death associated with all stages of CKD. Additionally, eHealth holds much promise for enhancing the delivery of healthcare in CKD and it is vital to determine which strategies are effective at promoting behaviour change and improve outcomes in CKD.

OBJECTIVES

This review aimed to evaluate the benefits and harms of using eHealth interventions to change health behaviours in people with CKD.

METHODS

Criteria for considering studies for this review

Types of studies

All RCTs and quasi-RCTs (RCTs in which allocation to treatment was obtained by alteration, use of alternate medical records, date of birth or other predictable methods) will be included.

Types of participants

Adults and children who have been diagnosed with CKD (i.e. predialysis, dialysis and kidney transplant recipients) were included.

Diagnosis of CKD is defined by estimated GFR (eGFR) < 60 mL/min or, eGFR < 90 mL/min with albuminuria or haematuria, for at least three months or as defined using other clinically indicated criteria.

Types of interventions

Any interventions that the authors report to be using eHealth technologies to promote behaviour change in CKD. eHealth technologies include:

- Telephone and Telehealth
- Mobile phone (including applications available on these devices)
- Computers and tablets (including applications available on these devices)
- Personal Digital Assistants
- Internet (including e-mail)
- Electronic transmission (e.g. using technologies such as Bluetooth)
- Social Media
- Electronic decision support tools.

The comparisons were as follows.

1. eHealth intervention versus non-eHealth intervention
2. eHealth intervention versus alternate eHealth intervention
3. eHealth intervention versus no intervention or usual care

Meta-analyses were conducted by analysing similar interventions of the same classifications (e.g. educational versus reminder systems) together for analysis.

Types of outcome measures

Time intervals at which outcome assessment takes place may affect the effect of the intervention programs. We considered all time frames used by authors.

1. Clinical parameters

- Electrolyte management (measured using biochemical measurements)
- Kidney function (measured using eGFR and/or serum creatinine)
- Fluid management (measured using interdialytic weight gain (IDWG))
- Co-morbidity management (measured using BP control, dyslipidaemia, HbA1c, fasting and random blood glucose readings, anthropometry)
- Hospitalisation rates
- Death (all causes)

2. Patient-centred parameters

- Dietary intake and behaviours (measured using self-reported data and qualitative and quantitative surveys)
- Physical activity behaviours (using validated tools, quantitative and qualitative surveys, self-reported data)
- Adherence to medications (using validated or self-reported data)
- Adherence to appointments (using validated or self-reported data)
- Quality of life (measured using global or disease-specific validated tools)
- Nutritional status (measured using validated tools)
- Self-management and self-efficacy
- Satisfaction with interventions.

3. Cost effectiveness

- Incremental cost-effectiveness ratios (defined as the cost per quality-adjusted life year gained)
- Cost per Disability Adjusted Life Years (DALY)
- Costs associated with eHealth intervention.

4. Potential harms

- Additional patient or health professional time associated with the use of eHealth intervention
- Anxiety due to frequent monitoring
- Accidents or accidental deaths associated with using the eHealth intervention (e.g. reading text message while driving).

Search methods for identification of studies

Electronic searches

We searched the Cochrane Kidney and Transplant Register of Studies up to 14 January 2019 through contact with the Information Specialist using search terms relevant to this review. The Register contains studies identified from the following sources.

1. Monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL)
2. Weekly searches of MEDLINE OVID SP
3. Handsearching of kidney-related journals and the proceedings of major kidney and transplant conferences
4. Searching of the current year of EMBASE OVID SP
5. Weekly current awareness alerts for selected kidney journals
6. Searches of the International Clinical Trials Register (ICTRP) Search Portal and ClinicalTrials.gov.

Studies contained in the Register are identified through searches of CENTRAL, MEDLINE, and EMBASE based on the scope of Cochrane Kidney and Transplant. Details of search strategies, as well as a list of handsearched journals, conference proceedings and current awareness alerts, are available in the *Specialised Register* section of information about Cochrane Kidney and Transplant.

See Appendix 1 for search terms used in strategies for this review.

Searching other resources

1. Reference lists of review articles, relevant studies and clinical practice guidelines.
2. Letters seeking information about unpublished or incomplete trials to investigators known to be involved in previous studies.

Data collection and analysis

Selection of studies

We used the search strategy described to obtain titles and abstracts of studies relevant to the review. Two authors screened the titles and abstracts independently, studies that are not applicable were discarded. However, studies and reviews thought to include rele-

vant data or information on studies were retained initially. Two authors independently assessed retrieved abstracts, and when necessary the full text, of these studies to determine studies that satisfied the inclusion criteria.

Data extraction and management

Data extraction was carried out independently by the same authors using standard data extraction forms. Studies reported in non-English language were translated before assessment. Where more than one publication of a study was found, only the publication with the most complete data was included, however when relevant outcomes were only published in earlier versions these data were used. Further information required from the original author was requested by written correspondence and any relevant information obtained in this manner was included in the review. Disagreements were resolved in consultation with a third author.

Assessment of risk of bias in included studies

The following items were assessed independently by two authors using the risk of bias assessment tool (Higgins 2011) (*see* Appendix 2).

- Was there adequate sequence generation (selection bias)?
- Was allocation adequately concealed (selection bias)?
- Was knowledge of the allocated interventions adequately prevented during the study?
  - Participants and personnel (performance bias)
  - Outcome assessors (detection bias)
- Were incomplete outcome data adequately addressed (attrition bias)?
- Are reports of the study free of suggestion of selective outcome reporting (reporting bias)?
- Was the study apparently free of other problems that could put it at a risk of bias?

Measures of treatment effect

For dichotomous outcomes (e.g. incidence of ESKD, death) results were expressed as risk ratio (RR) with 95% confidence intervals (CI). Where continuous scales of measurement were used to assess the effects of treatment (e.g. quality of life, body weight), the mean difference (MD) was used, or the standardised mean difference (SMD) if different scales have been used, also reporting 95% confidence intervals (CI).

Unit of analysis issues

For studies with multiple treatment groups we combined all relevant experimental intervention groups of the study into a single group and combined all relevant control intervention groups into a single group to enable single pairwise comparison.

Dealing with missing data

Any further information required from the original authors was requested by email correspondence and relevant information obtained in this manner was included in the review. Evaluation of important numerical data such as screened, randomised patients as well as intention-to-treat, as-treated and per-protocol population was carefully performed. Attrition rates, losses to follow-up and withdrawals were investigated. Issues of missing data and imputation methods (for example, last-observation-carried-forward) was critically appraised (Higgins 2011).

Assessment of heterogeneity

We first assessed the heterogeneity by visual inspection of the forest plot. Heterogeneity was then analysed using a Chi^2 test on N-1 degrees of freedom, with an alpha of 0.05 used for statistical significance and with the I^2 test (Higgins 2003). A guide to the interpretation of I^2 values was as follows.

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity
- 50% to 90%: may represent substantial heterogeneity
- 75% to 100%: considerable heterogeneity.

The importance of the observed value of I^2 depends on the magnitude and direction of treatment effects and the strength of evidence for heterogeneity (e.g. P-value from the Chi^2 test, or a confidence interval for I^2) (Higgins 2011).

Assessment of reporting biases

Due to the small number of studies we were unable to assess for the existence of small study bias using funnel plots.

Data synthesis

We classified our studies by target of intervention (educational, reminder system, educational plus reminders, behavioural counselling, self-monitoring and clinical decision aid). Treatment estimates for specified outcomes (those that were reported by two or more studies) were summarised within groups of intervention types and treatment effects were summarised using random-effects meta-analysis. The eHealth interventions and associated implementation strategies were described using the "Better reporting of interventions: Template for Intervention Description and Replication (TIDieR) checklist and guide" (Hoffmann 2014) and tabulated in the review.

Subgroup analysis and investigation of heterogeneity

Subgroup analysis was used to explore possible sources of heterogeneity. In our protocol we stated we would conduct subgroup analysis based on technology (e.g. mobile phone, internet). However, classifying interventions using technology type did not explain heterogeneity between interventions. Additionally, classification of studies by the World Health Organization's framework of interventions for clients (Appendix 3) did not provide sufficient subgroup differentiation as the majority of studies could be classified into two types of interventions: targeted communication to clients and personal health tracking. We determined that heterogeneity between eHealth interventions was better explained by the target of the intervention (e.g. educational versus self-monitoring) and therefore we used these classifications when conducting subgroup analyses. There were insufficient extractable data to conduct subgroup and univariate meta-regression analysis to explore the following variables as possible sources of heterogeneity: mean study age, mean proportion of men, adequacy of allocation concealment, sample size, and duration of follow up (< 12 months versus ≥ 12 months).

Sensitivity analysis

There were insufficient extractable data to perform the following sensitivity analyses in order to explore the influence of the following factors on effect size:

- Repeating the analysis excluding unpublished studies
- Repeating the analysis taking account of risk of bias, as specified
- Repeating the analysis excluding any very long or large studies to establish how much they dominate the results
- Repeating the analysis excluding studies using the following filters: diagnostic criteria, language of publication, source of funding (industry versus other), and country.

'Summary of findings' tables

We presented the main results of the review in 'Summary of findings' tables. These tables present key information concerning the quality of the evidence, the magnitude of the effects of the interventions examined, and the sum of the available data for the main outcomes (Schünemann 2011a). The 'Summary of findings' table includes an overall grading of the evidence related to each of the main outcomes using the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) approach (GRADE 2008; GRADE 2011). The GRADE approach defines the quality of a body of evidence as the extent to which one can be confident that an estimate of effect or association is close to the true quantity of specific interest. The quality of a body of evidence involves consideration of within-trial risk of bias (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias (Schünemann 2011b).

The key outcomes presented in the Summary of findings table 1 include:

- Death
- Fluid management
- Dietary intake (sodium).

RESULTS

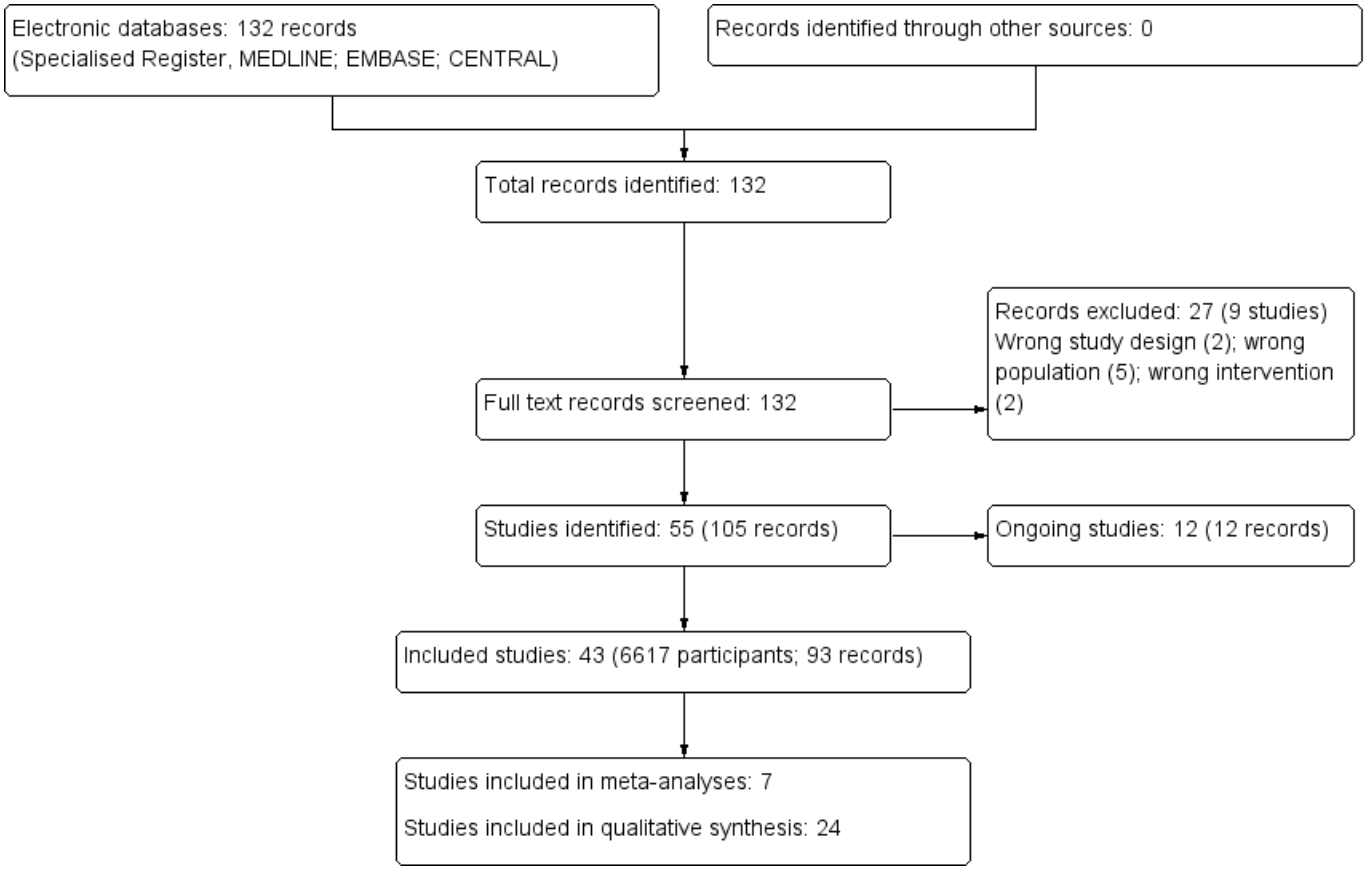
Description of studies

See Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies.

Results of the search

We searched the Specialised Register and identified 132 records. After screening titles and abstracts and full-text review, 43 studies (93 records) were included and nine studies (27 records) were excluded. Twelve ongoing studies were identified (CONNECT 2017; eNEPHRO 2017; Jung 2017; KARE 2015; Kosaka 2017; MAGIC 2016; NCT00394576; NCT02097550; NCT02610946; TELEGRAFT 2015; Waterman 2015; WISHED 2016), These 12 studies and will be assessed in a future update of this review (Figure 1).

Figure 1. Study flow diagram.



Included studies

We included 43 studies (93 reports; 6617 participants) in this review. The included studies were conducted between 1999 and 2017, with the majority published since 2010 (38 of 43 studies, 88%). Nine studies (Durand 2000; Halleck 2017; Han 2016; Hardstaff 2002; Jammalamadaka 2015; Ong 2017; Potter 2016; SUBLIME 2016; White 2010) (23%) had only abstracts from conference proceedings or short reports available. All studies were published in English. The majority of studies were conducted in an adult population (39 studies), and the majority of studies were conducted in North America (26 studies). Eleven studies enrolled 4315 participants with pre-dialysis CKD, 10 studies enrolled 681 participants on haemodialysis (HD), six studies enrolled 281 participants on peritoneal dialysis, 15 studies enrolled 1281 kidney transplant recipients, and one study enrolled 288 transplant candidates. Participant numbers ranged from 6 to 2199 (mean study population, 153; median study population, 75), with study durations varying from one clinic appointment to 24 months (median follow-up period was 16 weeks). Most (20 studies) compared an eHealth intervention to usual care involving traditional methods (e.g. face-to-face counselling), 11 studies did not adequately describe the control group and 12 studies compared an active eHealth intervention to a passive, control eHealth intervention. Studies used various eHealth technologies including: Telehealth (e.g. phone calls, video monitoring, teleconferencing) (10 studies), mobile phone or tablet applications (11 studies), mobile phone text messaging or emails (2 studies), electronic monitors (11 studies), internet or website (4 studies), video or DVD (2 studies), or mixed methods, where more than one eHealth technology was used (3 studies). Table 1 provides an overview of the characteristics of included studies.

Our study classifications were as follows:

- Educational (four studies: Baraz 2014; Diamantidis 2015; Giacoma 1999; InformMe 2017)
- Reminders (6 studies: Halleck 2017; Han 2016; Henriksson 2016; Jammalamadaka 2015; McGillicuddy 2013; Potter 2016)
- Self-monitoring (9 studies: BALANCEWise-HD 2011; BALANCEWise-PD 2011; Koprucki 2010; Kullgren 2015; Ong 2017; Rifkin 2013; Schulz 2007; Welch 2013; Williams 2017)
- Behavioural counselling (16 studies: BalanceWise-HD 2013; BRIGHT 2013; Cargill 2003; iDiD 2016; Ishani 2016; Kargar Jahromi 2016; Li 2014b; MESMI 2010; Poorgholami 2016a; Reilly-Spong 2015; Russell 2011; Schmid 2016; Swallow 2016; TAKE-IT 2014; White 2010)
- Clinical decision-aids (4 studies: Cooney 2015; Durand 2000; Hardstaff 2002; iChoose 2016)
- Mixed interventions (4 studies: Navaneethan 2017; Reese 2017; Robinson 2014a; Robinson 2015)

Of the 43 studies, seven studies reported outcome data used in quantitative analyses, while data from 24 studies could only be presented descriptively. Eleven studies could not be included in qualitative analyses due to insufficient reporting of outcome data (Cargill 2003; Diamantidis 2015; Giacoma 1999; Halleck 2017; Han 2016; Ong 2017; SUBLIME 2016; White 2010) or data was only being available for the intervention group (BALANCEWise-HD 2011, BALANCEWise-PD 2011; Swallow 2016). Reported outcomes were broadly categorised as:

Clinical parameters

- Blood pressure control (9 studies)
- Biochemical parameters (6 studies)
- Clinical end-points (16 studies)

Patient-centred parameters

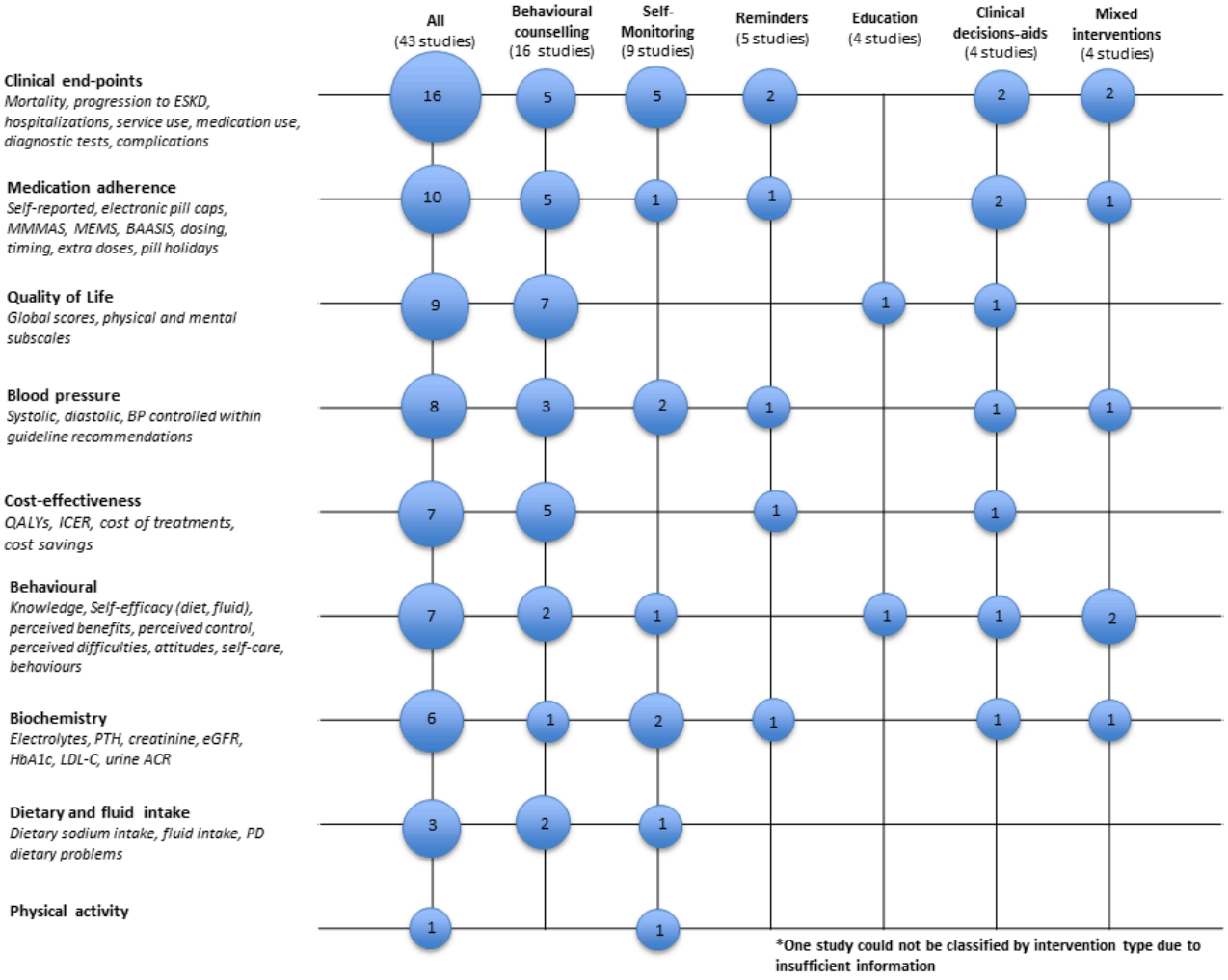
- Dietary intake (3 studies)
- Quality of life (9 studies)
- Medication adherence (10 studies)
- Behaviour (7 studies)
- Physical activity (1 study)

Cost-effectiveness

- Cost-analysis (7 studies)

We identified 98 outcomes within these domains. However, 65 outcomes (66%) were only reported by single studies. Additionally, due to the heterogeneity of interventions only three outcomes (dietary sodium intake, IDWG and death) were able to be quantitatively analysed. Tables 2 to 7 (Table 2; Table 3; Table 4; Table 5; Table 6; Table 7) contain descriptive analyses for reported outcomes. Figure 2 depicts a bubble plot of reported outcomes.

Figure 2. Bubble plot of reported outcomes by intervention type



Excluded studies

Nine studies (27 reports) were excluded during title and full text screening. The reasons for exclusion were study population did not have CKD (Abdel-Kader 2011; Korus 2017; RaDIANT 2014; Roberto 2009; Wilson 2014), interventions did not include eHealth (Chen 2011e; SMILE 2010) and the wrong study design (Morales-Barria 2016; Warren 2009).

Risk of bias in included studies

Figure 3 provides a summary of the risk of bias for the included studies with the study-level data provided in Figure 4. Methodological quality varied considerably, with many studies providing insufficient information to accurately assess the risk of bias.

Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

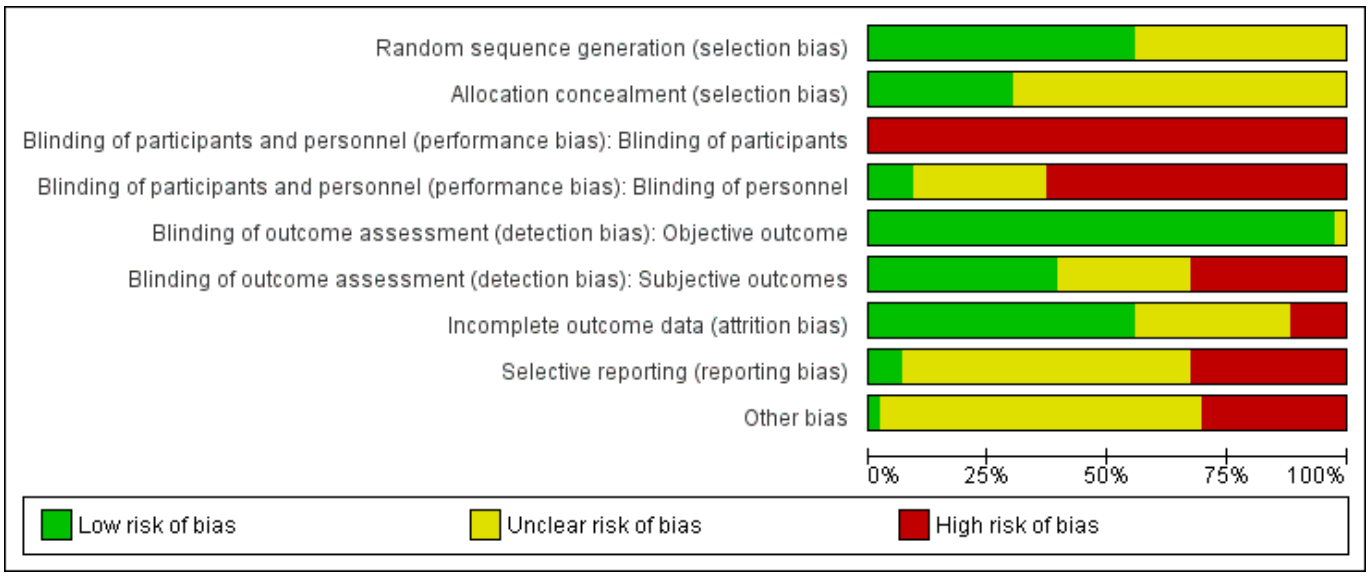


Figure 4. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

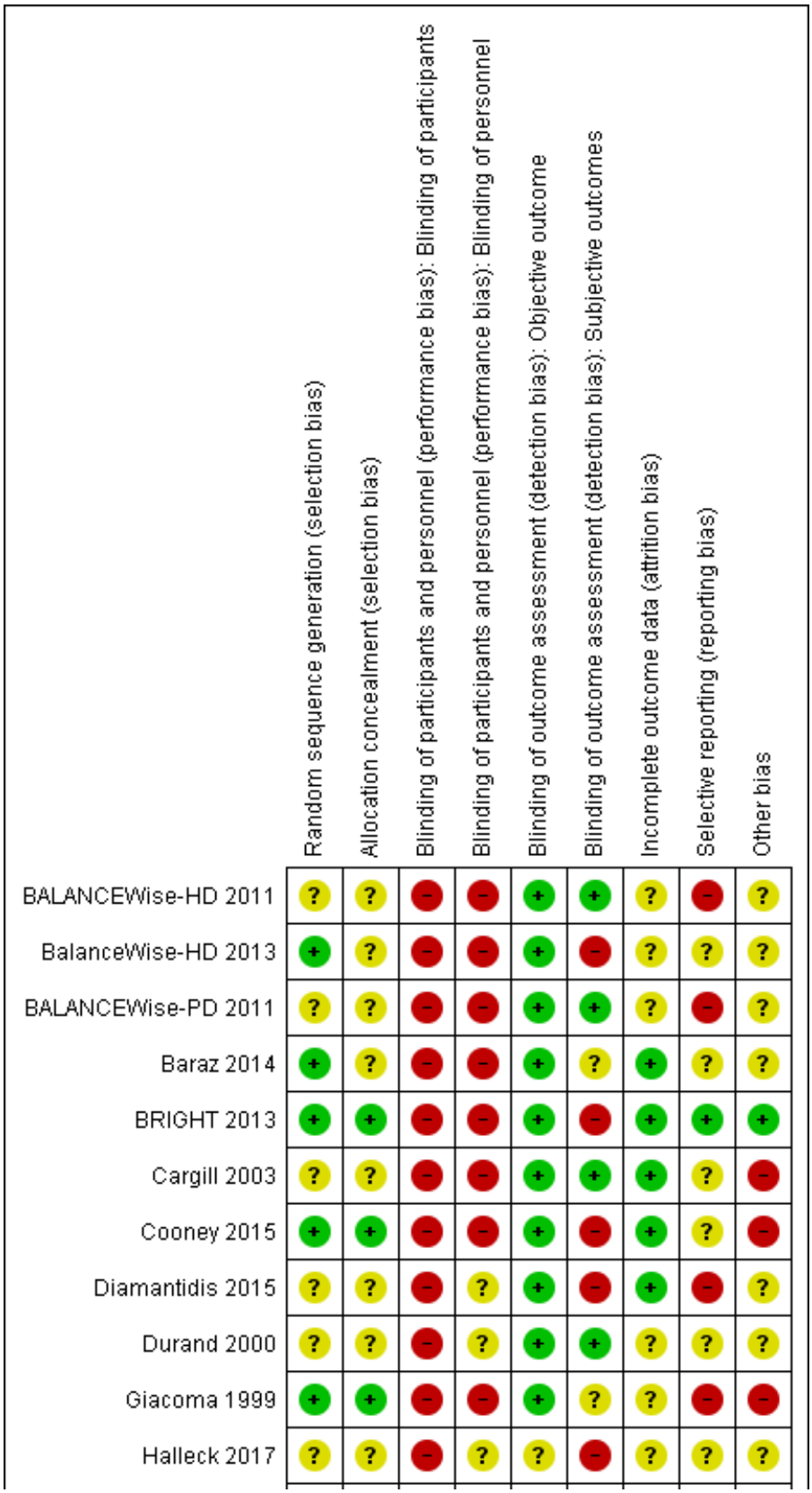


Figure 4. (Continued)

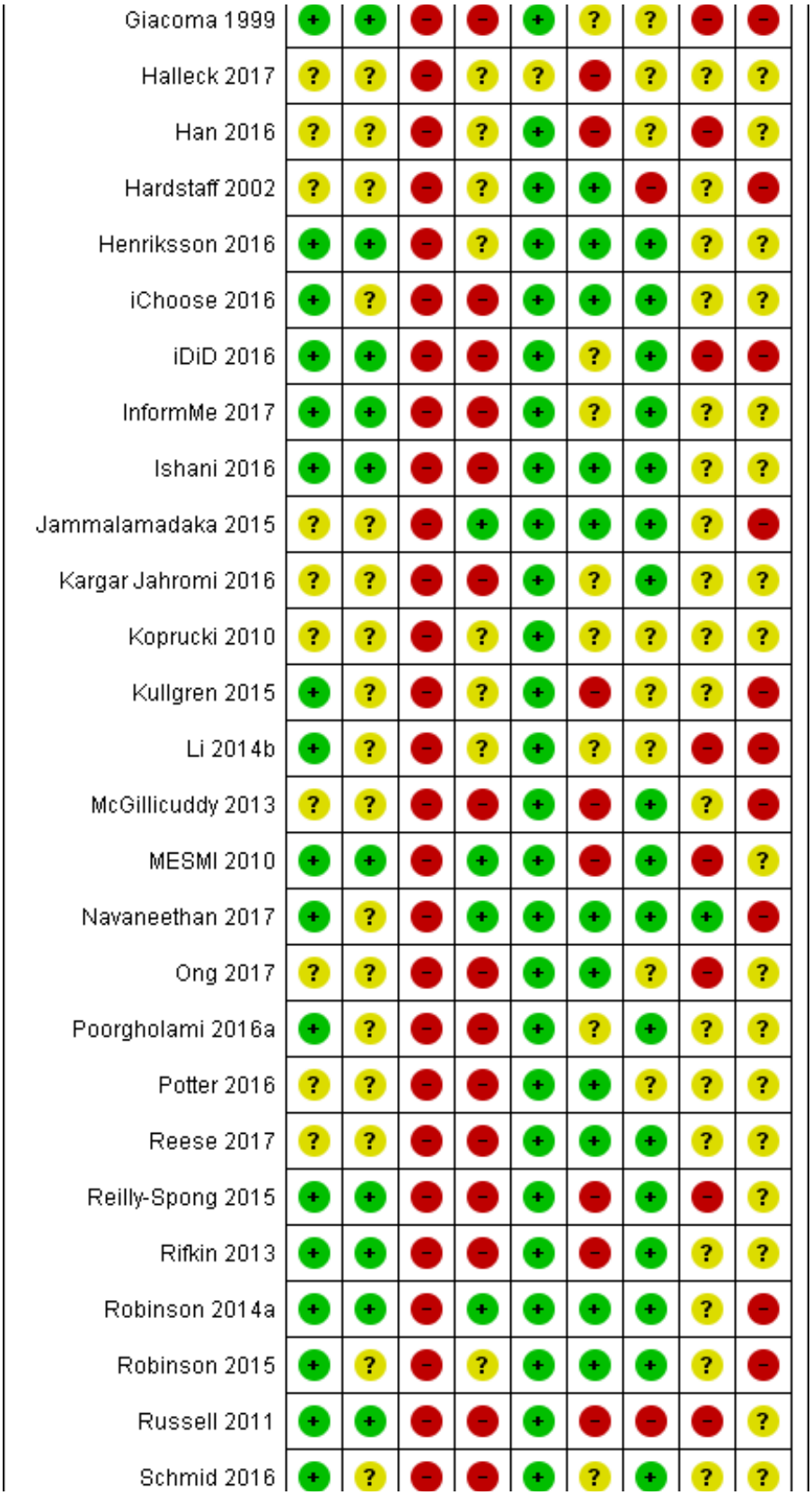
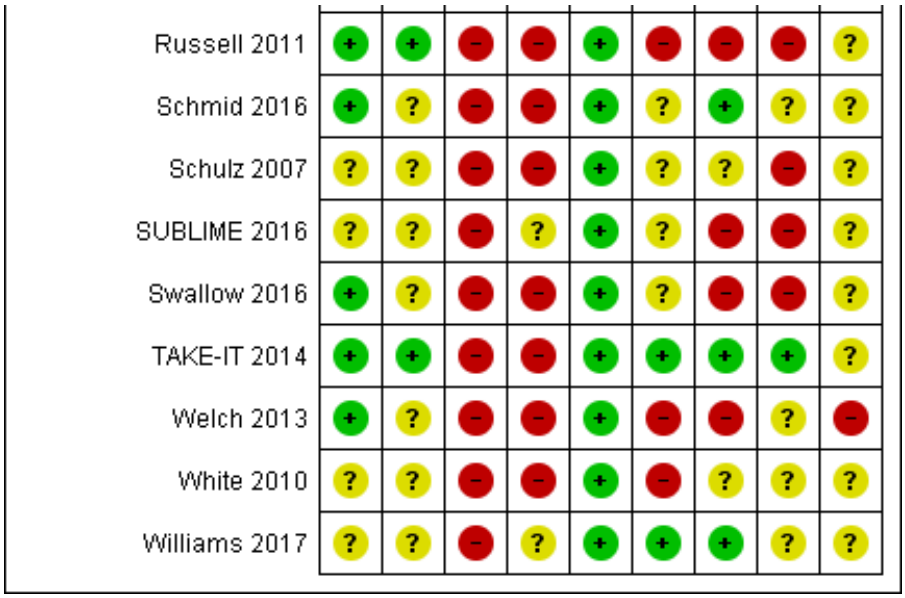


Figure 4. (Continued)



Allocation

Random sequence generation

Random sequence generation was assessed as low risk of bias in 24 studies (BalanceWise-HD 2013; Baraz 2014; BRIGHT 2013; Cooney 2015; Giacoma 1999; Henriksson 2016; iChoose 2016; iDiD 2016; InformMe 2017; Ishani 2016; Kullgren 2015; Li 2014b; MESMI 2010; Navaneethan 2017; Poorgholami 2016a; Reilly-Spong 2015; Rifkin 2013; Robinson 2014a; Robinson 2015; Russell 2011; Schmid 2016; Swallow 2016; TAKE-IT 2014; Welch 2013), and unclear in the remaining 19 studies.

Allocation concealment

Allocation concealment was assessed at low risk of bias in 13 studies (BRIGHT 2013; Cooney 2015; Giacoma 1999; Henriksson 2016; iDiD 2016; InformMe 2017; Ishani 2016; MESMI 2010; Reilly-Spong 2015; Rifkin 2013; Robinson 2014a; Russell 2011; TAKE-IT 2014), and unclear in the remaining 30 studies with insufficient information to permit judgment.

Blinding

Performance bias

Performance bias (participants) was assessed as being at high or unclear risk of bias in all studies.

In four studies (Jammalamadaka 2015; MESMI 2010; Navaneethan 2017; Robinson 2014a) performance bias (personnel) was assessed to be at low risk of bias. Twenty-seven studies were assessed to be at high risk of bias (BALANCEWise-HD 2011; BalanceWise-HD 2013; BALANCEWise-PD 2011; Baraz 2014; BRIGHT 2013; Cargill 2003; Cooney 2015; Giacoma 1999; iChoose 2016; iDiD 2016; InformMe 2017; Ishani 2016; Kargar Jahromi 2016; McGillicuddy 2013; Ong 2017; Poorgholami 2016a; Potter 2016; Reese 2017; Reilly-Spong 2015; Rifkin 2013; Russell 2011; Schmid 2016; Schulz 2007; Swallow 2016; TAKE-IT 2014; Welch 2013; White 2010) and unclear in the remaining 12 studies.

Detection bias

Detection bias (objective outcomes) was assessed to be at low risk of bias in 42 studies, and unclear in one study (Halleck 2017).

Detection bias (subjective outcomes) was assessed as being at low risk of bias in 17 studies (BALANCEWise-HD 2011; BALANCEWise-PD 2011; Cargill 2003; Durand 2000; Hardstaff 2002; Henriksson 2016; iChoose 2016; Ishani 2016; Jammalamadaka 2015; Navaneethan 2017; Ong 2017; Potter 2016; Reese 2017; Robinson 2014a; Robinson 2015; TAKE-IT 2014; Williams 2017), high risk of bias in 14 studies (BalanceWise-HD 2013; BRIGHT 2013; Cooney 2015; Diamantidis 2015; Halleck 2017; Han 2016; Kullgren 2015; McGillicuddy 2013; MESMI 2010; Reilly-Spong 2015; Rifkin 2013; Russell 2011; Welch 2013; White 2010), and unclear in the remaining 12 studies.

Incomplete outcome data

Twenty-four studies were considered to be low risk of attrition bias (Baraz 2014; BRIGHT 2013; Cargill 2003; Cooney 2015; Diamantidis 2015; Henriksson 2016; iChoose 2016; iDiD 2016; InformMe 2017; Ishani 2016; Jammalamadaka 2015; Kargar Jahromi 2016; McGillicuddy 2013; MESMI 2010; Navaneethan 2017; Poorgholami 2016a; Reese 2017; Reilly-Spong 2015; Rifkin 2013; Robinson 2014a; Robinson 2015; Schmid 2016; TAKE-IT 2014; Williams 2017). Five studies (Hardstaff 2002; Russell 2011; SUBLIME 2016; Swallow 2016; Welch 2013) were assessed to be at high risk of bias as more than 20% of participants were lost to follow-up; the remaining 14 studies were unclear due to insufficient information.

Selective reporting

Studies were considered to be at high risk of bias if data were provided in a format which could not be entered into the meta-analyses or if stated outcomes were not reported. We assessed three studies (BRIGHT 2013; Navaneethan 2017; TAKE-IT 2014) to be at low risk of reporting bias. Fourteen studies were assessed at high risk of reporting bias (BALANCEWise-HD 2011; BALANCEWise-PD 2011; Diamantidis 2015; Giacoma 1999; Han 2016; iDiD 2016; Li 2014b; MESMI 2010; Ong 2017; Reilly-Spong 2015; Russell 2011; Schulz 2007; SUBLIME 2016; Swallow 2016), and the remaining 26 studies were unclear due to insufficient information. Ten studies only had abstracts or short reports available, limiting our ability to accurately assess reporting bias.

Other potential sources of bias

One study was assessed to be at low risk of other potential bias due to transparent reporting and following protocol (BRIGHT 2013). Thirteen studies were assessed to be at high risk of bias (Cargill 2003; Cooney 2015; Giacoma 1999; Hardstaff 2002; iDiD 2016; Jammalamadaka 2015; Kullgren 2015; Li 2014b; McGillicuddy 2013; Navaneethan 2017; Robinson 2014a; Robinson 2015; Welch 2013), and the remaining 29 studies were assessed to have unclear risk due to insufficient information.

Effects of interventions

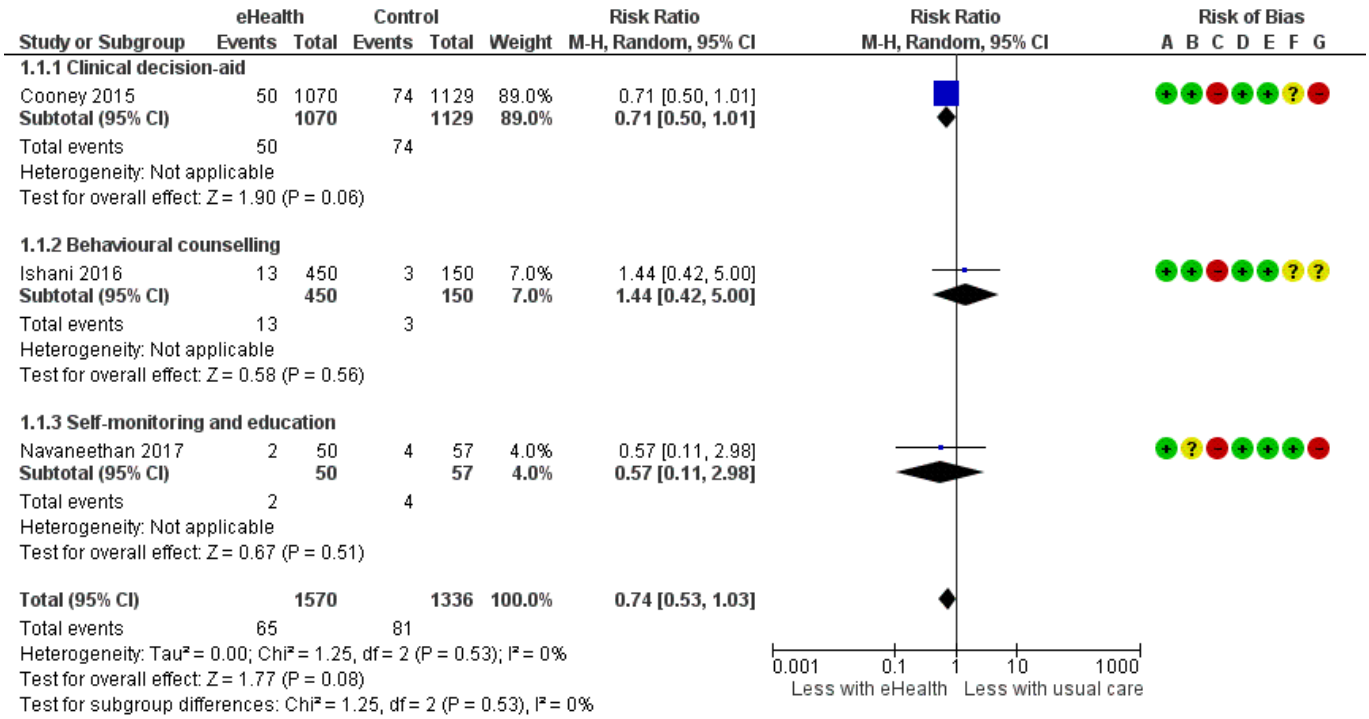
See: **Summary of findings for the main comparison** EHealth interventions compared to standard care in chronic kidney disease populations

Because of considerable heterogeneity in the population, interventions, and outcomes, we were unable to generate meaningful summary estimates with the exception of death, self-management for IDWG and dietary sodium intake. The remainder of the studies are grouped by six categories of interventions and the results summarized descriptively.

Death (all causes)

Three studies conducted in pre-dialysis CKD populations using behavioural counselling (Ishani 2016), education (Navaneethan 2017), and clinical decision-aid (Cooney 2015) interventions reported death (Figure 5). The certainty of evidence was considered to be very low due to high or uncertain risk of bias, imprecision and indirectness. We are uncertain whether employing various eHealth interventions reduces the number of deaths (Analysis 1.1 (3 studies, 2906 participants): RR 0.74, 95% CI 0.53 to 1.03; I^2 = 0%).

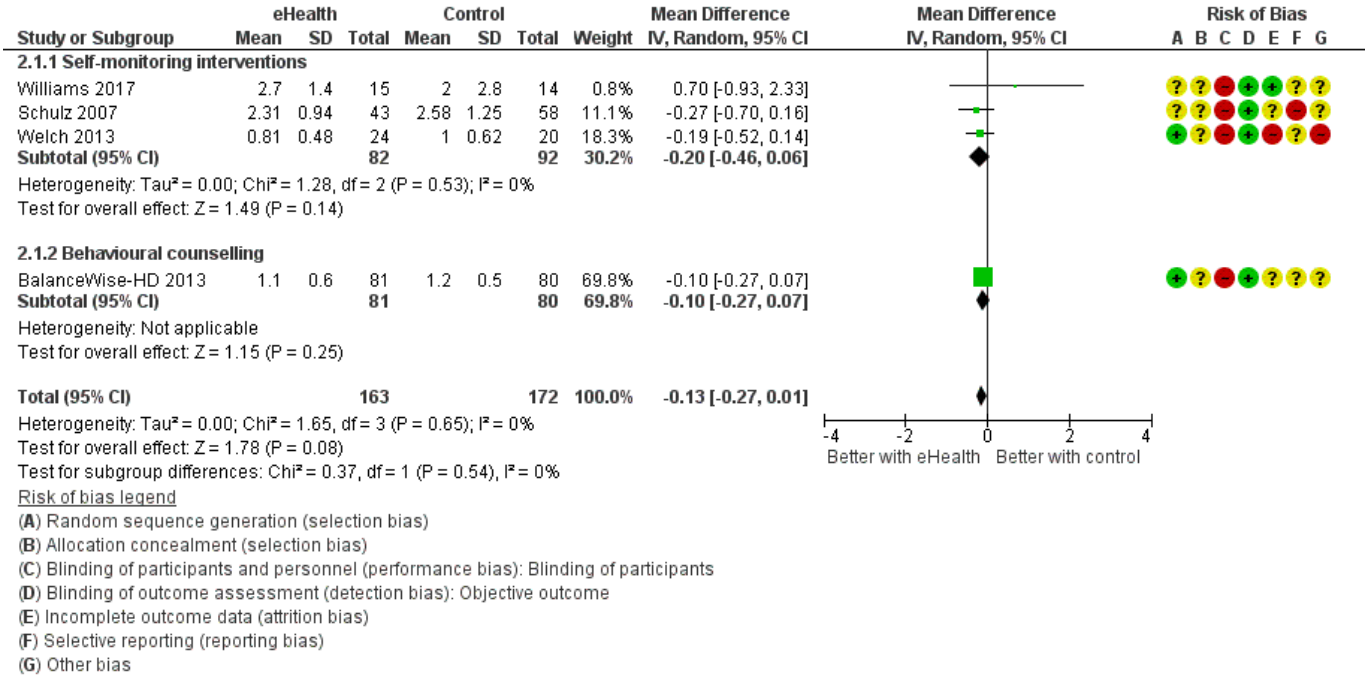
Figure 5. Forest plot of comparison: 1 Death, outcome: 1.1 Death.



Interdialytic weight gain

Four studies conducted in HD-dependent populations using self-management (BalanceWise-HD 2013) and self-monitoring interventions (Schulz 2007; Welch 2013; Williams 2017) reported IDWG (Figure 6). The certainty of evidence was considered to be low due to high or uncertain risk of bias and indirectness. Participants using electronic self-monitoring devices (e.g. personal digital assistants, Fitbit Flex or wireless body weight scales) reduced their average IDWG by 0.13 kg. Using an eHealth intervention to enhance patient self-monitoring may lead to slightly improved IDWG when compared to a non-eHealth intervention usual care group (Analysis 2.1 (4 studies, 335 participants): MD -0.13 kg, 95% CI -0.27 to 0.01; I^2 = 0%).

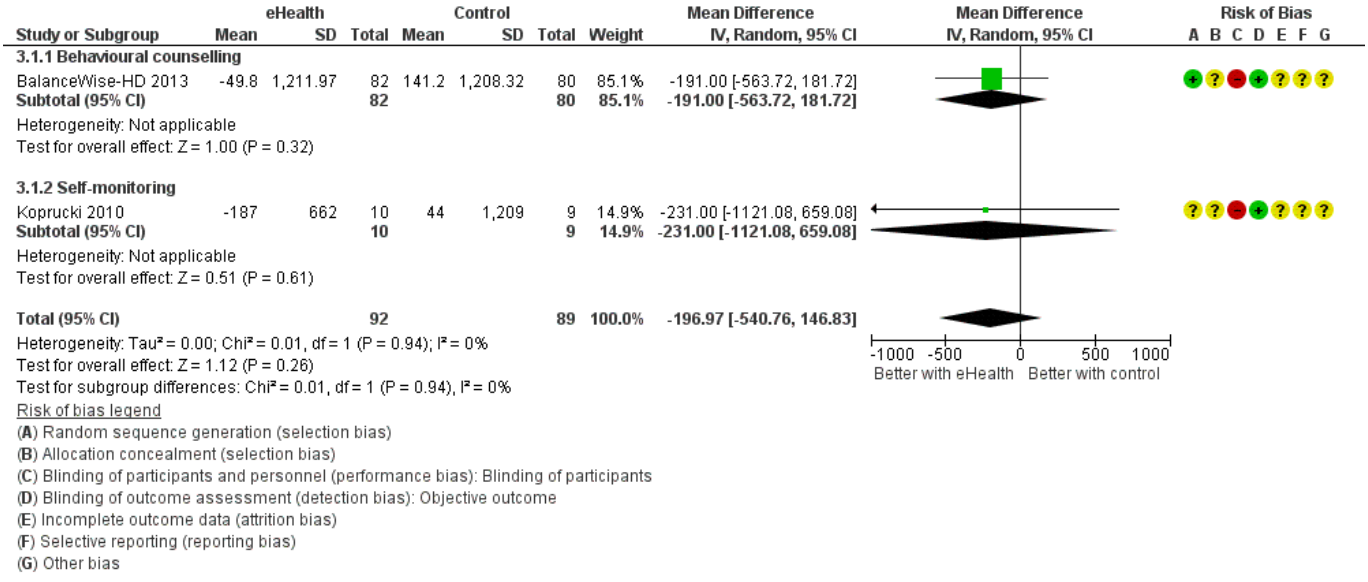
Figure 6. Forest plot of comparison: Interdialytic weight gain



Dietary sodium intake

Two studies using behavioural counselling (BalanceWise-HD 2013; SUBLIME 2016) and one using self-monitoring interventions (Koprucki 2010) reported dietary sodium intake. Two were able to be combined due to similarities in target population (dialysis-dependent populations), study length, and eHealth intervention used (BalanceWise-HD 2013; Koprucki 2010) (Figure 7). The certainty of evidence was considered to be low due to high or uncertain risk of bias and imprecision (small sample size). Participants using an electronic dietary monitoring application consumed 197 mg less sodium/day. Self-monitoring interventions with additional counselling from a clinician (e.g. use of personal digital assistants to track dietary intake with dietetic consultation) may lead to slightly improved dietary sodium intakes in a dialysis-dependent population (Analysis 3.1 (2 studies, 181 participants): MD -196.97, 95% CI -540.76 to 146.83; I^2 = 0%). SUBLIME 2016 did not provide sufficient detail to be included in the meta-analysis, however they reported a statistically significant improvement in dietary sodium intake following a three-month internet-based self-management intervention in CKD population when compared to a non-eHealth control group.

Figure 7. Forest plot of comparison: 5 Dietary sodium, outcome: 5.1 Dietary sodium intake.



Educational interventions

Educational interventions were defined as interventions aimed at improving knowledge and skills that can be acquired by learning and instruction.

Four studies (Baraz 2014; Diamantidis 2015; Giacoma 1999; InformMe 2017) involving 457 participants evaluated educational interventions. Studies were conducted in various populations, including CKD (20 participants) (Diamantidis 2015), HD (90) (Baraz 2014), kidney transplant candidates (288) (InformMe 2017), and kidney transplant recipients (59) (Giacoma 1999).

A range of technologies were used, including iPad application (Diamantidis 2015; InformMe 2017), mobile phone text messaging (Diamantidis 2015), and video (Baraz 2014, Giacoma 1999). Three studies (Giacoma 1999, Baraz 2014, InformMe 2017) compared the eHealth intervention to usual in-person education, while Diamantidis 2015 compared two eHealth interventions.

Knowledge was measured by Giacoma 1999 and InformMe 2017. Knowledge improved in the iPad education group compared to usual care (Analysis 8.1.1: SMD 0.59, 95% CI 0.35, 0.82; P < 0.001) (InformMe 2017) and post video-based education (t = 4.9; P < 0.0001) (Giacoma 1999) (Table 2). InformMe 2017 evaluated participants willingness to accept a high risk donor kidney (Table 2), however there was no significant difference between the participants receiving education modules on an iPad app and those receiving usual care (Analysis 10.3.1: MD -0.20, 95% CI -0.44 to 0.03; P = 0.09). Baraz 2014 evaluated a number of quality of life domains using the SF-36 (Table 2). There was no significant difference between oral or video education in any domains of physical or emotional quality of life. Diamantidis 2015 evaluated usability of text messaging and iPad applications and reported low rate of errors in both the text messaging and iPad application groups, however did not provide sufficient information for analysis. All outcomes reported in educational interventions are outlined in Table 2.

Reminder interventions

Reminder interventions were defined as systems used to prompt or aid the memory. The systems can be audible or visual alarms, computerized reminders or phone calls or messaging.

Five studies (Han 2016; Henriksson 2016; Jammalamadaka 2015; McGillicuddy 2013; Potter 2016) involving 311participants evaluated a reminder intervention. Studies were conducted in kidney transplant recipients (271 participants) (Han 2016; Henriksson 2016; McGillicuddy 2013; Potter 2016) and HD (40) (Jammalamadaka 2015). Wireless or electronic medication trays with audible and/or visual alarms (Henriksson 2016; McGillicuddy 2013; Potter 2016), mobile phone application (Han 2016), and mobile phone text message reminders (Jammalamadaka 2015) were evaluated. All five studies compared the use of an eHealth intervention to usual care.

Adherence was evaluated by three studies (Han 2016; Henriksson 2016; McGillicuddy 2013). McGillicuddy 2013 reported an improvement in medication adherence at three months (Analysis 6.2.3: MD 3.22, 95% CI 1.76 to 4.68). Henriksson 2016 only evaluated adherence in the intervention group and reported 97.9% compliance with immunosuppressive treatment at three months and 96% at 10 to 12 months. Han 2016 reported no difference in adherence between the intervention and control groups (74.1% versus 66.1%, P = 0.36). Both Potter 2016 and Henriksson 2016 reported number of biopsies performed, with Potter 2016 reporting less biopsies in the intervention group (4 versus 9). Conversely, Henriksson 2016 reported a higher rate of biopsies performed in the intervention group, with 32 biopsies needed in 17 participants, compared to 60 biopsies needed in 38 control participants. All outcomes reported in reminder interventions are detailed in Table 3.

Self-monitoring interventions

Self-monitoring interventions were defined as interventions that are aimed at measuring one's target behaviour and comparing to an external standard or goal that can result in lasting improvements in behaviour.

Nine studies (BALANCEWise-HD 2011; BALANCEWise-PD 2011; Koprucki 2010; Kullgren 2015; Ong 2017; Rifkin 2013l Schulz 2007; Welch 2013; Williams 2017) involving 498 participants utilised a self-monitoring intervention. Studies were conducted in HD (215 participants) (BALANCEWise-HD 2011; Schulz 2007; Welch 2013; Williams 2017), peritoneal dialysis (45) (BALANCEWise-PD 2011; Koprucki 2010), CKD (206) (Ong 2017; Rifkin 2013), and paediatric kidney transplant recipients (32) (Kullgren 2015). Personal digital assistant (BALANCEWise-HD 2011, BALANCEWise-PD 2011; Koprucki 2010; Welch 2013), telemetric bodyweight machine (Schulz 2007), an interactive water bottle (Kullgren 2015), Fitbit Flex physical activity tracker (Williams 2017), and wireless transmission of clinical data to a healthcare team (Rifkin 2013) were evaluated. One study compared an interactive dietary monitoring application to a passive physical activity log (Welch 2013). Williams 2017 compared the use of a Fitbit Flex tracker with feedback regarding physical activity and sleep to no feedback. Koprucki 2010 compared an interactive dietary monitoring application plus computer-based education module versus computer-based education module alone. The remaining four studies (BALANCEWise-HD 2011; Kullgren 2015; Rifkin 2013; Schulz 2007) compared an eHealth intervention to usual care.

Systolic and diastolic blood pressure was reported by three studies (Ong 2017; Rifkin 2013; Schulz 2007). Rifkin 2013 found no significant change in systolic or diastolic blood pressure between eHealth and usual care groups. Schulz 2007 found no significant chance in systolic blood pressure, however did report a significant improvement in diastolic blood pressure with the use of telemetric body weight scales compared to usual care. Ong 2017 reported a significant reduction in systolic and diastolic blood pressure with the use of a blood pressure self-monitoring application that provided feedback, compared to a passive self-monitoring application (MD -5 mmHg and -3.5 mmHg respectively).

Williams 2017 was the only study to report physical activity, and reported no difference in physical activity with the use of a Fitbit Flex with feedback on progress or no feedback on progress. Kullgren 2015 reported a significantly higher fluid intake in the intervention group using an interactive water bottle compared to those in the control group, however there were no differences in serum sodium, urea, or creatinine.

No data from BALANCEWise-HD 2011 or BALANCEWise-PD 2011 could be reported as only intervention group data was reported.

All outcomes reported in self-monitoring interventions are outlined in Table 4.

Behavioural counselling interventions

Behavioural counselling interventions were defined as interventions aimed at enabling patients to assume responsibility for managing their condition through the systematic provision of education and supportive interventions to increase skills and confidence in managing health problems, and included regular assessment and/or progress, goal setting and problem solving support.

Sixteen studies (BalanceWise-HD 2013; BRIGHT 2013; Cargill 2003; iDiD 2016; Ishani 2016; Kargar Jahromi 2016; Li 2014b; MESMI 2010; Poorgholami 2016a; Reilly-Spong 2015; Russell 2011; Schmid 2016; SUBLIME 2016; Swallow 2016; TAKE-IT 2014; White 2010) involving 2069 participants utilised a behavioural counselling intervention. Studies were conducted in CKD (1240 participants) (BRIGHT 2013; Ishani 2016; MESMI 2010; SUBLIME 2016; Swallow 2016), HD (339) (BalanceWise-HD 2013; iDiD 2016; Kargar Jahromi 2016; Poorgholami 2016a), peritoneal dialysis (206) (Cargill 2003; Li 2014b; White 2010), kidney transplant recipients (124) (Schmid 2016; Reilly-Spong 2015; Russell 2011), and adolescent kidney transplant recipients (169) (TAKE-IT 2014). Telephone (Kargar Jahromi 2016; Li 2014b; Poorgholami 2016a), telephone plus website (BRIGHT 2013; iDiD 2016), telephone plus DVD education (MESMI 2010), videoconferencing support (Cargill 2003; Schmid 2016; Reilly-Spong 2015; White 2010), Telehealth support with wireless transmission of clinical data (Ishani 2016), websites (SUBLIME 2016; Swallow 2016), personal digital assistants (BalanceWise-HD 2013), and electronic medication monitors with clinician support (Russell 2011; TAKE-IT 2014) were evaluated. One study compared a videoconferencing to telephone support (Reilly-Spong 2015), All other studies compared eHealth to non-eHealth usual care.

Fatigue was evaluated by three studies (BRIGHT 2013; Li 2014b; Reilly-Spong 2015), with no differences detected between eHealth intervention and control groups in any studies. Four studies (Schmid 2016; MESMI 2010; Russell 2011; TAKE-IT 2014) evaluated medication adherence.

Three studies (Russell 2011; Schmid 2016; TAKE-IT 2014) reported significant improvements in medication adherence when using electronic monitoring plus clinician counselling. Russell 2011 reported a significant improvement in medication adherence using electronic medication monitoring with nurse education (SMD 1.27, 95% CI 0.01 to 2.53; P = 0.039). Similarly Schmid 2016 reported a significant improvement in medication adherence utilising video monitoring support with a multidisciplinary team (RR 1.90, 95% CI 1.15 to 3.14; P = 0.013). TAKE-IT 2014 reported a significant improvement in both medication taking adherence (OR 1.66, CI 1.15 to 2.39) and timing adherence (OR 1.74, CI 1.21 to 2.50) using personalised coaching with electronic medication reminders. There was no difference in medication adherence in eHealth intervention or control groups reported by MESMI 2010.

Anxiety was evaluated by four studies (BRIGHT 2013; iDiD 2016; Kargar Jahromi 2016; Reilly-Spong 2015). Kargar Jahromi 2016 reported a significant reduction in anxiety following a one month telephone follow-up intervention (MD -5.15, 95% CI -6.29 to -4.01; P = 0.01), however BRIGHT 2013, iDiD 2016 and Reilly-Spong 2015 found no difference in anxiety levels between eHealth intervention and control groups.

Depression was evaluated by three studies (iDiD 2016; Kargar Jahromi 2016; Reilly-Spong 2015). Whilst Kargar Jahromi 2016 reported significantly less depression in the telephone follow-up group (MD -5.09, 95% CI -6.22 to -3.96; P = 0.05), Reilly-Spong 2015 reported higher levels in the eHealth intervention group receiving group teleconference support when compared to those a one-on-one telephone support (MD 0.72, 95% CI 0.15 to 1.28; P = 0.05). iDiD 2016 reported no difference in levels of depression when comparing an online CBT intervention versus online CBT with telephone support.

Three studies evaluated blood pressure (BRIGHT 2013; Ishani 2016; MESMI 2010). BRIGHT 2013 reported a significant improvement in blood pressure control when utilising a multi-modal eHealth intervention (telephone follow-up and website) compared to usual care. Ishani 2016 and MESMI 2010 reported no difference in blood pressure control.

Two studies (Ishani 2016; Li 2014b) evaluated hospital readmission rates, however no difference was found between eHealth intervention and control groups.

All outcomes reported by behavioural counselling interventions are outlined in Table 5.

Clinical decision-aid interventions

Clinical decision-aids provided clinicians or patients with knowledge and person-specific information presented at times to enhance decision-making.

Four studies (Cooney 2015; Durand 2000; Hardstaff 2002; iChoose 2016) involving 2543 participants utilised a clinical decision-aid intervention. Studies were conducted in various populations, including CKD (2642 participants) (Cooney 2015; iChoose 2016), kidney transplant recipients (100) (Hardstaff 2002), and peritoneal dialysis (30) (Durand 2000). Telephone follow-up (Cooney 2015), an online risk calculator (iChoose 2016), blue-tooth transmission of clinical data to clinicians (Durand 2000), and Smartcap medication caps (Hardstaff 2002) were evaluated. All four studies compared an eHealth intervention to usual care.

Medication adherence was evaluated by two studies (Cooney 2015; Hardstaff 2002). Hardstaff 2002 reported an improvement in medication adherence in the eHealth group compared to usual care (RR 1.9, 95% CI 1.15 to 3.14). Cooney 2015 reported no significant difference in medication adherence between those receiving telephone follow-up and those who did not (MD -0.08, 95% CI -0.17 to 0.00); however 51.5% of the intervention group did not receive the intervention. Cooney 2015 reported a lower rate of death in the intervention group, however this did not reach statistical significance (RR 0.71, 95% CI 0.5 to 1.01; P = 0.06).

All outcomes reported in clinical decision-aid interventions are outlined in Table 6.

Mixed interventions

Four studies (Navaneethan 2017; Reese 2017; Robinson 2014a; Robinson 2015) involving 602 participants employed interventions with multiple strategies. Three studies were conducted in kidney transplant recipients (Reese 2017; Robinson 2014a; Robinson 2015) and one study in CKD (Navaneethan 2017). Reese compared usual care to a reminder intervention and a reminder plus education

intervention. Robinson 2014a compared a paper based education module electronic reminders to usual care; Robinson 2015 compared an iPad education module with electronic reminders top usual care; and Navaneethan 2017 compared usual care (electronic self-monitoring) to usual care plus education (direction to an educational website).

Knowledge, self-care behaviours, attitudes towards performing behaviour and willingness to perform behaviour were evaluated by two studies (Robinson 2014a; Robinson 2015). There was a significant improvement in knowledge, self-care behaviours, attitudes towards performing behaviour and willingness to perform behaviour in the eHealth intervention groups of both studies.

Reese 2017 reported a significant improvement in medication adherence from three to six months of the study with 55% adherence in usual care versus 78% in the reminders group and 88% in the reminders plus education group (P < 0.001).

Navaneethan 2017 reported no significant difference in rate of kidney function decline, rate of hospitalisations, dialysis initiation or transplantation and death during the two year study period between usual care and the additional educational intervention group.

All outcomes reported in mixed intervention studies are detailed in Table 7.

Cost-analysis

Seven of 43 studies described costs associated with delivery of the eHealth intervention. Five studies (BRIGHT 2013; Durand 2000; Henriksson 2016; Schmid 2016; SUBLIME 2016) reported cost-savings associated with the use of eHealth interventions. Positive cost-analyses were based on cost of unexpected treatments (e.g. rejections, unplanned hospital admissions, increased specialist consultant visits) being higher in control groups or intervention groups having lower cost of treatment due to improved disease control (reduced blood pressure, reduced sodium intake). Cargill 2003 reported significantly higher costs due to set up of videophones and internet lines and ongoing phone charges, and one study (iDiD 2016) reported increased costs due to the increased rate of inpatient hospital admissions, that the authors attributed to the unevenly distributed allocation to the intervention arm.

Acceptability and feasibility

Eighteen studies measured acceptability (e.g. satisfaction, ease of use) and feasibility (e.g. intervention adherence and uptake). Studies reported participant satisfaction due to ease of use, low burden of eHealth intervention, informative and enjoyment of increased interactions with healthcare staff. eHealth interventions were reported as feasible due to high uptake and high levels of participant satisfaction. However, technical issues (e.g. poor internet connection or device failure) were reported to limit intervention uptake (Cargill 2003; McGillicuddy 2013).

Harms

Only Henriksson 2016 reported that six participants had prematurely withdrawn from the electronic medication monitoring trial due to feeling overly monitored. Other potential harms were not reported by any studies.

DISCUSSION

Summary of main results

We identified 43 studies (93 reports, 6617 participants) that were conducted using a variety of eHealth technologies to replace or enhance standard care in CKD. eHealth interventions were evaluated for a mean of 12 weeks (ranging from one clinic appointment to 12 months), with the majority of studies (27; 63%) enrolling less than 100 participants. Interventions were classified as either educational, reminders, self-monitoring, behavioural counselling clinical decision aids or mixed interventions, and were either compared to traditional methods (e.g. face-to-face counselling) (20) or to a different eHealth intervention (12); in 11 studies the control group was not described. The studies included in this review involved people with CKD stage 1-5, dialysis-dependent populations, transplant recipients and transplant candidates; the majority of studies were conducted in an adult population (40 studies).

There was considerable heterogeneity between eHealth intervention designs and eHealth technologies used. The multiplicity of outcomes reported limited our ability to conduct meaningful meta-analyses. Only three outcomes could be meta-analysed (dietary sodium intake, IDWG, death) due to substantial variation between eHealth intervention, study population and study length. Clinical end-point outcomes were the most frequently reported, with 16 studies reporting 25 different clinical end-points, 19 of which were only reported by one study. Additionally, there was a substantial number of behavioural, biochemical, and quality of life outcomes reported by only one study, limiting our ability to synthesize the data and formulate conclusions. Also, high or unclear risk of bias in many of the included studies, combined with imprecision in effect measurements, indirectness of interventions and study populations and poor reporting of study results led to low confidence in results. No studies in this review reported on outcomes related to physical activity or nutritional status.

Overall, these data suggest that current evidence for eHealth interventions in the CKD population is of low quality and is insufficient to guide clinical practice. However, possible benefits may be reduced costs relating to patient care. The increasing use of technology in people's lifestyles, and the high levels of participant satisfaction and acceptability reported by studies, suggest that eHealth interventions may offer an adjunct to usual care in CKD. However, due to the low and very low quality of evidence it is unclear whether eHealth interventions alone alter health related behaviours in CKD population. Additionally, it remains unclear whether eHealth interventions offer a cost-effective alternative to current treatment models.

Overall completeness and applicability of evidence

The strengths of this review include comprehensive systematic searching for eligible studies, rigid inclusion criteria for RCTs and data extraction and analysis by two independent investigators, which limited the risk of errors in determining study eligibility, data extraction, risk of bias assessment, and data synthesis. We aimed to evaluate the effectiveness of eHealth interventions to improve a range of important outcomes for people with CKD. We could not robustly assess the effect of eHealth as there were few studies of sufficient size and duration with adequate reporting of methods and outcomes to examine clinical or patient outcomes. The variability in outcome measures and measurement tools used limited

our ability to synthesize the data, and the use of standardised outcomes would be helpful in the future.

Quality of the evidence

We assessed the quality of evidence using GRADE methodology. Full-length journals were available for 33 studies, whilst 10 studies had only abstracts or short reports available. Included studies were commonly reported incompletely and were of poor methodological quality. The majority of studies were assessed to be at high risk or uncertain risk of bias relating to selection bias, performance bias, detection bias (subjective outcomes), reporting bias, and other biases. The high level of uncertain risk of bias assessment was due to poor methodological and outcome reporting of studies.

The overall certainty of evidence using GRADE was assessed as low for dietary sodium intake and IDWG. Our ability to conduct meta-analyses was limited due to small, heterogeneous study populations, substantial variability of eHealth technologies used and the multiplicity of reported outcomes.

Potential biases in the review process

Potential biases in this review relate to the data availability in the individual studies. Firstly, the small number of data observations limited our ability to conduct robust statistical estimates of heterogeneity and meant we could not assess for potential publication bias due to the small number of studies. Secondly, studies were frequently at high risk of bias but poorer quality studies could not be excluded from sensitivity analyses due to the limited number of data observations. Thirdly, adverse event reporting in the available studies was inconsistent and infrequent. Finally, whilst a comprehensive search of the Cochrane Kidney and Transplant Specialised Register was performed for this review, reducing the possibility that potential eligible studies were omitted from the review, eligible studies published after the last search date or published in congress proceedings not routinely searched could have been missed.

Agreements and disagreements with other studies or reviews

Systematic reviews have evaluated the impact of various eHealth interventions such as telephone or mobile phone text message reminders (Beratarrechea 2014; Hamine 2015), electronic reminders (Tao 2015; Vervloet 2012) and electronic medication packaging (Checchi 2014) on treatment and medication adherence in non-CKD, chronic disease populations. These reviews have reported positive improvements in medication adherence and appointment adherence, however similar to our review, authors highlighted poor methodological quality limiting the results of these interventions. Tao 2015 evaluated 22 RCTs (3152 participants) reported a 29% improvement in medication adherence with the use of electronic reminders (95% CI 0.18 to 0.41; P = 0.00). Similar to our findings, the authors highlight that the small number of studies and high heterogeneity of interventions limited results and any robust conclusions.

We were unable to conduct sensitivity analyses due to the small number of studies included in our meta-analyses; we could not form any conclusions about the impact of type of technology used, behaviour change techniques and intensity of intervention. However in previous literature, it has been reported that eHealth interventions that were individualised and incorporated strategies such as self-monitoring, personalised feedback and group or peer support resulted in significantly better outcomes, such as weight loss and diet and physical activity behaviours (Cotter 2014; Raajimakers 2015). It has also been reported that web, mobile phone text messaging and telemedicine technologies were more effective at improving CVD outcomes, than email, mobile phone, applications and monitoring sensors (Widmer 2015). Similar to our review, other systematic reviews evaluating eHealth interventions have been limited by small number of studies of low methodological quality. A previous systematic review of mobile technology interventions reported that overall usability, feasibility and acceptability were high among end-users, and resulted in increased self-management and knowledge (Hamine 2015). Our review also indicates that participant satisfaction was high for eHealth interventions (including video monitoring, Telehealth, dietary monitoring applications and websites). Similar to previous reviews (Kitsiou 2017; Sanyal 2018), economic evaluation of interventions in our review was lacking and insufficient to evaluate the cost-effectiveness of these interventions.

AUTHORS' CONCLUSIONS

Implications for practice

Overall, these data suggest that current evidence for the use of eHealth interventions in the CKD population is of low quality and insufficient to make a recommendation regarding their use to improve clinical care. Further cost-analysis data is needed to ascertain whether eHealth interventions offer a cost-effective alternative to standard practice. However, eHealth interventions appear to be acceptable to patients and feasible if technical issues are managed. Our findings indicate that eHealth interventions utilising behavioural counselling or self-monitoring may help to improve fluid management and dietary sodium intake in dialysis patients, however further evaluation is needed. This has been supported by studies conducted in other chronic diseases (Cotter 2014; Raajimakers 2015) that found interventions using self-monitoring, personalized feedback and peer group support improved outcomes. Current evidence from our review was insufficient to make recommendations for incorporation of specific eHealth strategies to enhance current care. Utilizing self-monitoring techniques, providing personalized feedback and facilitating peer group support may enhance future practice and should be further evaluated in the CKD population.

Implications for research

Questions remain about the impact of eHealth interventions on clinical end-points and patient-centred outcomes in the CKD population, with additional studies in CKD required to evaluate the impact of eHealth interventions to patient care. Future research should focus on larger scale trials to allow for meaningful interpretation of results. Additionally, evaluation and reporting of trials should be based on established frameworks that maintain methodological quality.
Our review has highlighted the need for robust, high quality research that reports core (minimum) data set as outlined by the SONG collaboration (SONG 2017), including both clinical and patient-centred outcomes, to enable meaningful evaluation of literature. Further, cost-effectiveness, process and qualitative evaluations of interventions are needed to ensure robust assessment of the impact of these interventions.

Evidence of the use of established frameworks to design and evaluate the interventions included in this review, such as the Behaviour Change Wheel, CONSORT-EHEALTH, RE-AIM, was lacking. Fu-

ture studies would benefit from drawing on frameworks that require theoretical modelling between processes and outcomes and a process evaluation of the study (Craig 2008; Michie 2013). All studies should provide greater description of intervention and standard models of care being assessed (Hoffmann 2014; Warner 2017) and include process evaluations of how they are being implemented (Moore 2013), using reporting guidelines for complex interventions.

In diabetic populations the use of these alert systems has improved medication adherence (Tao 2015) and highlights an important area in CKD that warrants further evaluation. Our systematic review reported on five studies using electronic alerts however due to small sample sizes and poor methodological quality we have been unable to provide recommendations for the use of these alerts. Based on our findings and previous literature (Cotter 2014; Raajimakers 2015) interventions incorporating self-monitoring and personalised counselling should be further pursued.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

BALANCEWise-HD 2011

Methods	• Study design: parallel RCT; 98 HD patients assessed for eligibility; 22 randomised • Study duration: 16 weeks • Study follow-up: 16 weeks
Participants	• Country: USA • Setting: multicentre (3 sites) • Dialysis-dependent CKD • Number (randomised/completed): intervention group (11/9); control group (11/10) • Mean age ± SD (years): intervention group (56 ± 15.9); control group (not reported) • Sex (M/F): intervention group (6/4); control group (not reported) • Race: intervention group (9/10 minority race); control group (not reported) • Exclusion criteria: could not read or write; planned to move out of area or change dialysis centres during the study period

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention: PDA application
	
	Intervention group
	
	• PDA-based diet self-monitoring
	  * PDA-based dietary self-monitoring using a nutrient database with individual nutrient and calorie goals as per renal dietitian. Electronic food diary logs uploaded when meeting face to face
	  * 16 weeks of dietary counselling based on Social Cognitive Theory. Primarily focused on moderating dietary sodium intake, additional counselling if electronic record suggested inadequate protein or caloric intake or laboratory markers showing hyperphosphataemia or hyperkalaemia. Counselling conducted face-to-face occurring twice a week during weeks 1 to 6, weekly during weeks 7 to 12, and every other week for weeks 13 to 16
	
	Control group
	
	• Not reported

Outcomes	Adherence to diet self-monitoring (intervention group only) • Number of meals entered
Notes	• No other publications for this study identified • Funding source: work was supported by the following grants: Paul Teschan Research Foundation, NIH/NIDDK/DK-R21DK067181, NIH/NCRR/CTSA-UL1-RR024153,and NIH/NCRR/GCRC-M01- RR000056

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias)	High risk	The intervention and attention control activities were conducted by study staff as an addition to, but not as a replacement for, standard care

BALANCEWise-HD 2011 *(Continued)*

Blinding of personnel		
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Number of meals entered was an objective measure
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	High risk	Primary outcomes were not reported
Other bias	Unclear risk	Inadequate sample size to meet power calculation

BalanceWise-HD 2013

Methods	• Study design: parallel RCT; 257 HD patients assessed for eligibility; 179 randomised • Study duration: September 2009 to September 2012 • Study follow-up: 16 weeks
Participants	• Country: USA • Setting: multicentre (3 sites) • Dialysis-dependent CKD for at least 3 months • Number (randomised/completed): intervention group (93/81) control group (86/79) • Median age, IQR (years): intervention group (62, 53-71); control group (60, 50-69) • Sex (M/F): intervention group (57/36); control group (44/41) • Exclusion: could not read, write, or speak English; could not see the PDA or use a stylus to make selections from the PDA screen; had overt dementia; planned to move out of the area or change dialysis centres or receive living donor transplant within the study period; life expectancy of less than 12 months; institutionalised; those who were unwilling to speak 1 to 2 times/week with a study dietitian or record their food consumption during the 16-week study period

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention: PDA application
	
	Intervention group
	
	• PDA-based diet self-monitoring
	  * 6 education sessions with dietitian before PDA self-monitoring PDA dietary self-monitoring + twice weekly behavioural counselling for 8 weeks and once weekly weeks 9-12 and every second week weeks 13-16
	
	Control group
	
	• Attention control
	  * 6 education sessions with dietitian; received PDA programmed with nutritional requirements at end of study

Outcomes	• IDWG (measured at baseline, 8 and 16 weeks) • Dietary sodium intake (measured at baseline, 8 and 16 weeks): measured using 24 hour dietary recalls

BalanceWise-HD 2013 *(Continued)*

	• Adherence to intervention (number of meals entered and appointments attended): measured in the intervention group only at 16 weeks • Perceived difficulties and determinants of dietary intake (measured at 16 weeks): 34-item questionnaire using Likert scale, pertaining to problems they encountered in following HD diet in previous 2 months
Notes	• Dialysis adequacy statistically significant in attention control group at baseline (P < 0.001) • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised using a permuted block algorithm developed by the study statistician
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	The intervention and attention control activities were conducted by study staff
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Use of objective measures (IDWG, adherence)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Self-reported dietary sodium intake and perceived difficulties questionnaire are subjective
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Overall 89.4% completion rate - reasons for drop out reported but no mention if significantly different
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

BALANCEWise-PD 2011

Methods	• Study design: parallel RCT; 30 peritoneal dialysis patients assessed for eligibility; 26 randomised • Study duration: 16 weeks • Study follow-up: 16 weeks
Participants	• Country: USA • Setting: multicentre (3 sites) • Dialysis-dependent CKD

BALANCEWise-PD 2011 *(Continued)*

- Number (randomised/completed): intervention group (13/11); control group (13/10)
- Mean age ± SD (years): intervention group (51.7 ± 19.8); control group (not reported)
- Sex (M/F): intervention group (7/6); control group (not reported)
- Race: intervention group (8/13 minority race); control group (not reported)
- Exclusion criteria: could not read or write; planned to move out of area or change dialysis centres during the study period

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: PDA application
	
	Intervention group
	
	• PDA-based diet self-monitoring
	  * PDA-based dietary self-monitoring using a nutrient database with individual nutrient and calorie goals as per renal dietitian. Electronic food diary logs uploaded when meeting face-to-face
	  * 16 weeks of dietary counselling based on Social Cognitive Theory. Primarily focused on moderating dietary sodium intake, additional counselling if electronic record suggested inadequate protein or caloric intake or laboratory markers showing hyperphosphataemia or hyperkalaemia. Counselling was conducted face-to-face or via telephone and occurred twice a week during weeks 1 to 6, weekly during weeks 7 to 12, and every other week for weeks 13 to 16
	
	Control group
	
	• Not reported

Outcomes	• Adherence to diet self-monitoring (intervention group only) * Number of meals entered
Notes	• Funding source: work was supported by the following grants: Paul Teschan Research Foundation, NIH/NIDDK/DK-R21DK067181, NIH/NCRR/CTSA-UL1-RR024153, and NIH/NCRR/GCRC-M01- RR000056

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	The intervention and attention control activities were conducted by study staff
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Number of meals entered was an objective measure
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured

BALANCEWise-PD 2011 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	High risk	Primary outcomes were not reported
Other bias	Unclear risk	Insufficient information to permit judgement

Baraz 2014

Methods	• Study design: quasi-experimental, pretest-post-test interventional study (using each subject as his/her own control); 155 assessed for eligibility, 97 participants randomised • Study duration: August 2013 to December 2013; conducted over 2 dialysis sessions • Study follow-up: 6 months
Participants	• Country: Iran • Setting: dialysis unit • HD patients age ≥ 18 years on HD for at least 6 months • Number (randomised/completed): intervention group (48/45); control group (49/45) • Mean age ± SD (years): intervention group (33.83 ± 8.89); control group (35.87 ± 10.13) • Sex (M): intervention group (46.6%); control group (51.1%) • Exclusion criteria: not reported

Interventions	• Intervention type classification: education
	• eHealth intervention used: video
	• The educational contents of both programs were similar and covered necessary information about the ESKD and dietary management for HD, particularly fluid restrictions and identification of restricted/allowed foods, as well as skin care and stress management
	
	Intervention group
	
	• Video education
	  * Educational contents were presented through showing a video film, watched during 2 consecutive dialysis sessions in a week
	
	Control group
	
	• Oral education
	  * 2 group education sessions were held after dialysis sessions. Duration of each session did not exceed 45 minutes. A teaching booklet regarding dietary control was given to each participant at the end of the session

Outcomes	Outcome measured at baseline and 6 months post intervention • QoL: using the Iranian version of the Short Form Health Survey (SF-36)
Notes	• Funding source: supported by Ahvaz Jundishapur University of Medical Sciences and financed by them

Risk of bias

Bias	Authors' judgement	Support for judgement

Baraz 2014 *(Continued)*

Random sequence generation (selection bias)	Low risk	Random allocation was performed by using the random computer-generated numbers
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded due to the nature of the intervention
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Principle investigator delivered the intervention
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Validated measure, however QoL is subjective and conducted in unblinded participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	6% to 8% loss-to-follow-up in both groups
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

BRIGHT 2013

Methods	• Study design: pragmatic, two-arm, patient-level RCT; 637 assessed for eligibility, 440 randomised • Study duration: April 2012 to November 2012 • Duration of follow-up: 6 months
Participants	• Country: UK • Setting: multicentre (24 sites) • Stage 3 CKD with or without proteinuria • Number (randomised/self-reported data/BP data): intervention group (215/180/193); control group (221/194/210) • Mean age ± SD (years): intervention group (72.4 ± 9.2); control group (71.8 ± 9.0) • Sex (M/F): intervention group (90/125); control group (91/130) • Exclusion criteria: unable to communicate in English; had reduced capacity to provide informed consent or were in receipt of palliative care
Interventions	• Intervention type classification: behavioural counselling • eHealth intervention used: Telehealth Intervention group

BRIGHT 2013 *(Continued)*

- BRIGHT intervention (participants could use resources at their discretion)
  * A kidney information guidebook.
  * PLANS (patient-led assessment for networks support) booklet and access to an interactive website with tailored access to local resources.
  * Telephone support from a dedicated peer support worker 2 telephone calls from lay health workers (week 1, week 5)

Control group

- Usual care
  * Offer kidney guidebook at end of study
  * No other description

Outcomes	Primary outcomes measured at baseline and 6 months • Blood pressure: dichotomised as "controlled" versus poorly controlled in accordance with 2008 NICE guidelines; <140/90 for those without proteinuria, <130/80 for those with proteinuria • Self-management: "The positive and Active Engagement in Life" domain of the validated HEiQ • HQoL: measured using EuroQoL EQ-5D Secondary outcomes measured at baseline and 6 months • Health status • Anxiety (general and CKD-specific) • Loneliness • Medication adherence • Social networks • Social involvement • Service utilisation and resource use for cost-effectiveness analysis Intervention uptake and evaluation measured at 6 months • Self-reported Intervention uptake and evaluation – kidney guidebook • Self-reported Intervention uptake and evaluation – PLANS website and booklet • Self-reported Intervention uptake and evaluation – telephone support call uptake
Notes	• Funding source: "The study was conducted as part of the NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC) Greater Manchester"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patient will be allocated to a trial arm via a minimization algorithm (incorporating a random component)
Allocation concealment (selection bias)	Low risk	Allocation adequately concealed using central allocation
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Quote: "Neither researchers or participants were blinded"
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Quote: "Neither researchers or participants were blinded"

BRIGHT 2013 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures at low risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Subjective measures self-report questionnaires filled out by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	Intervention Self-Report: 16.2% loss to follow-up Intervention BP: 9.4% loss to follow-up; intention-to-treat analyses
Selective reporting (reporting bias)	Low risk	All outcomes stated in the protocol were reported
Other bias	Low risk	No other biases detected

Cargill 2003

Methods	• Study design: parallel RCT; 7 adults and 6 paediatric families assessed for eligibility, 6 paediatric families randomised • Study duration: 3 months • Study follow-up: 3 months
Participants	• Country: UK • Setting: single centre • Patients with ESKD receiving PD • Number: intervention group (3); control group (3) • Mean age ± SD (years): intervention group (9.2 ± 6.8); control group (7.1 ± 4.1) • Sex: intervention group (0/3); control group (1/2) • Exclusion criteria: unable to have videophone installed

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	Intervention group
	• Telecare Intervention plus standard care
	  * Integrates Services Data Network (ISDN) 2E line and a motion media 225 mm videophone were installed that connected to similar videophone in nurses offices
	  * Use of videophone at the discretion of patient or family member
	  * All contacts by telephone/videophone and clinic/home/ward visits were recorded
	  * Support visit for 1st dialysis session and routine monthly clinic visit
	Control group
	• Standard care: support visit for 1st dialysis session and routine monthly clinic visit

Outcomes	Primary outcomes • Hospital visits and ward visits (measured at 3 months) • Cost-effectiveness (measured at 3 months) • Acceptability (assessed by conducting qualitative interviews)
Notes	• Originally aiming to also recruit adults which was unsuccessful

Cargill 2003 *(Continued)*

- Use of the videophone only occurred for 1 participant
- Funding source: partially funded by a grant from Trent Research and Development

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "randomised using sealed envelopes"
Allocation concealment (selection bias)	Unclear risk	Quote: "randomised using sealed envelopes"
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	No mention of blinding but likely this would have been broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures (hospitalisations, ward visits and cost of intervention) less likely to be biased
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants had outcome data reported
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Very low uptake of intervention; small sample size

Cooney 2015

Methods	• Study design: pharmacist led RCT; 44,698 assessed for eligibility, 2,199 were randomised • Study duration: 1 February 2011 to 31 January 2012 • Study follow-up: 12 months
Participants	• Country: USA • Setting: Community-based outpatient clinics (13 sites) • Moderate to severe CKD (eGFR < 45 mL/min and eGFR < 60mL/min in past 90 days to 2 years to confirm chronicity of disease) * CKD (non-dialysis dependent): men (98%); age (75.7 ± 8.2 years); black ethnicity (5%) • Number: intervention group (1070); control group (1129) • Mean age ± SD (years): intervention group 75.6 ± 8.2); control group (75.7 ± 8.2) • Sex (M/F): intervention group (1054/16); control group (1106/23) • Mean eGFR ± SD (mL/min/1.73 m^2): intervention group (34.2 ± 7.7); control group (34.5 ± 7.3)

Cooney 2015 *(Continued)*

	• Exclusion criteria: end-stage renal disease (ESRD), were ever referred for hospice care, or were older than 85 years or younger than 18 years
Interventions	• Intervention type classification: clinical decision-aid • eHealth intervention used: Telehealth Intervention group • Pharmacists provided telephone support reviewing medications and lifestyle modifications with the patients, ordering KDOQI recommended labs, and arranging nephrology consults for patients with severe CKD (eGFR < 30 mL/min/1.73 m^2). • Pharmacists provided self-management support by providing informational pamphlet regarding CKD management • Electronically communicated with primary care physicians • Electronic CKD registry Control group • Usual care * As per primary care physicians
Outcomes	• Baseline data were defined as the most recent clinic BP or laboratory value within the prior 12 months. Final clinic BP and laboratory values were defined as the last value during the study period Primary clinical outcome • SBP (only for those with baseline BP >130/80 mmHg) Primary process of care outcome • Serum PTH (measured within the study period) Secondary clinical outcomes • % participants at goal BP < 130/80 mmHg • QoL: (assessed using KDQoL burden, KDQoL effects, SF-12 MCS, SF-12 PCS, and conducted in subset of participants who had primary care appointment in first 3 months of study) • Incidence of ESKD (end of study period) • Death (end of study period) Secondary process of care outcomes • serum phosphorus • UACR • Number of anti-hypertensive medications prescribed to those with poorly controlled hypertension • appropriate treatment with ACEI/ARB, phosphorus binders, vitamin D and sodium bicarbonate • Medication adherence (assessed using Morisky's medication scale) • % seen by a nephrologist Acceptability • Satisfaction (Likert scale and open ended questions)
Notes	• 552 of 1070 participants randomised to intervention group never received the intervention • Funding source: "The study was funded in part by the Cleveland VA Medical Research & Education Foundation. Additional support was provided through a Career Development Award K23DK087919 (P.E.D.) from the National Institute of Diabetes and Digestive and Kidney Diseases"
Risk of bias	

Cooney 2015 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Blinded computer-generated randomisation list and a 1:1 ratio
Allocation concealment (selection bias)	Low risk	Blinded computer-generated randomisation list
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Personnel responsible for data collection and analysis were blinded to study group assignment, however study pharmacists conducted phone surveys and reviews so blinding would have been broken There were no study-related clinic visits for this pragmatic trial
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures at low risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	"study pharmacists" phone surveys assessed QoL, med adherence HL and acceptability "The phone surveys assessed health related quality of life (SF-12), medication adherence using the Morisky medication scale, Kidney Disease Quality of Life (KDQOL) Short form, health literacy, and the acceptability of the intervention"
Incomplete outcome data (attrition bias) All outcomes	Low risk	Used intention-to-treat analyses
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	No standardised methods for measuring BP, limited ability for the pharmacist to intervene, only 23% seen by Nephrologist, therefore medication doses etc would not have been changed, Only 518 patients in intervention group actually received intervention so this may have diluted the benefits

Diamantidis 2015

Methods	• Study design: usability RCT • Study duration: January 2013 to September 2013 • Study follow-up: 1 month

Participants	• Country: USA
	• Setting: community
	• Patients with CKD (< 60 mL/min)
	• Number: SMS group (10); PDA group (10)
	• Age:
	  * ≤ 65 years: SMS groups (7); PDA group (6)
	  * > 65 years: SMS group (3); PDA group (4)

Diamantidis 2015 *(Continued)*

	• Sex (M/F): SMS group (5/5); PDA group (7/3) • Exclusion criteria: expected to reach ESKD or die within 1 year from enrolment
Interventions	• Intervention type classification: education • eHealth intervention used: PDA and SMS • This study evaluates home-based usability of two mobile health MIS platforms • Participants asked to input each of 3 medications into respective MIS application and record device's responses on paper diary SMS text • Participants send the name of a medication by SMS text message • Receive a response text informing the patient of the medication's safety in CKD with three potential responses: not safe in CKD, use with caution/speak with your health care provider, and safe in CKD PDA • Allows users to search by the medication name or class (e.g., ibuprofen or pain medication) • PDA responses include traffic light imagery and text to emphasize safety responses: a red light for a medication that is not safe in CKD, a yellow light for use with caution/speak with your health care provider, and a green light for medications deemed safe in CKD
Outcomes	• Usability (assessed using error rates and satisfaction) • eHealth literacy (assessed using eHealth Literacy Scale)
Notes	• Funding source: " supported, in part, by the Baltimore Research and Education Foundation (C.J.D. and L.L.), the nonprofit corporation affiliated with the Veterans Affairs Maryland Health Care System, and National Institute of Diabetes and Digestive and Kidney Diseases Grant R01-DK084017 (to J.S.G., M.Y., and J.C.F.)"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Participants had to record what responses came out which may have resulted in some inaccurate answers being recorded by accident, satisfaction survey - no mention of whether validated or how it was administered but could be at risk of bias

Diamantidis 2015 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	No dropouts reported
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement
Other bias	Unclear risk	Trial patients not using their own medications or prescriptions, cash incentives small population - not necessarily representative. This was a usability trial

Durand 2000

Methods	• Study design: parallel RCT • Study duration: June 1999 to June 2000 • Study follow-up: mean time 9.5 months for intervention and 7.8 months for control group
Participants	• Country: France • Setting: community, dialysis unit • ESKD patients requiring PD • Number (for preliminary analysis): intervention group (15); control group (15) • Number (over 3-year study period): 94, unclear how many randomised into each study group • Mean age ±SD (years): not reported • Sex: not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: clinical decision-aid
	• eHealth intervention used: Blue-tooth, electronic monitoring
	
	Intervention group
	
	• DIATELIC telemedicine system
	  * Allows transmission of daily medical data from patient's home to medical centre.
	  * Patients set up with computer station and connects to database to record daily parameters: weight, pro and decubitus BP, UF and tonicity of dialysate
	  * All connections on secure internet
	  * Medical data analysed using Markov model to establish probability of hydration status diagnosis.
	  * Integrated email system to improve doctor-patient communication
	
	Control group
	
	• Usual care: no description

Outcomes	• Frequency of planned visits to medical centre • Frequency of unexpected visits • Hospitalisation rate • Decrease in BP • Number of anti-hypertensive medications • Weight/hydration status • Cost analysis • Number of emails sent/processed
Notes	• 3 abstracts with different patient numbers and results available

Durand 2000 *(Continued)*

- Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Unlikely could have been blinded as transmitting information
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Unlikely personnel could have been blinded due to receiving information from patients, no mention of blinding
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	All outcome measures are objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Giacoma 1999

Methods	• Study design: quasi-RCT, pre-test post-test; 62 assessed for eligibility, 59 randomised • Study duration: day 5 post surgery • Study follow-up: 2 days (day 7 post surgery)
Participants	• Country: USA • Setting: inpatient • Kidney transplant recipients • Number: 59 • Mean age ± SD (years): 41.1 ± 13.7 years (range 20 to 69 years) • Sex (M): 57.6% • Exclusion criteria: not reported
Interventions	• Intervention type classification: education • eHealth intervention used: video

Giacoma 1999 *(Continued)*

	Intervention group
	• Teaching video
	  * Reviewed kidney transplant medications and second discussed general post discharge care activities.
	  * Discharge information covered content pertaining to medication use, precautions, adverse effects and transportation; monitoring vital signs; recognising signs of infection and rejection; dietary recommendations; clinic location; healthy lifestyle behaviours; steps to prevent common complications
	• Standard care
	
	Control group
	• Standard care (conducted prior to surgery and day 5 post-surgery)
	  * Use of teaching checklist and review of discharge booklet which covered content pertaining to drugs, adverse effects and signs/symptoms of rejection
	  * Conducted prior to surgery and 5 days post surgery

Outcomes	Outcomes measured at baseline and day 7 of admission • Knowledge of Organ Transplant test (short-term knowledge retention) - not validated Outcomes measured day of admission, day of surgery, days 1, 2, 3, 7, 10 post surgery and day of discharge • Biochemistry (serum BUN, creatinine) • Urine 24-hour protein and CrCl • medication compliance assessed by serum TAC/CSA levels • primary reason for hospital admission (unclear how long this data was collected) • Long-term knowledge retention (assessed using frequency and reason for post-discharge phone calls (unclear how long this data was collected)
Notes	• Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Sealed envelopes were randomly picked by participants
Allocation concealment (selection bias)	Low risk	Sealed envelope draw with non replacement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Unblinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	No mention of whether personnel were blinded. Nurse gave knowledge questionnaire and then provided video - so unlikely impossible to blind person giving intervention
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Blinding would not affect outcome as objective

Giacoma 1999 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Nurse administering, non-validated questionnaire who was aware of allocation. No mention of whether this nurse was blinded to the allocation.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement, reported outcomes (i.e. long term knowledge retention) was not originally stated in methods.
Other bias	High risk	Small sample size and not powered; use of non-validated knowledge questionnaire

Halleck 2017

Methods	• Study design: randomised controlled trial, 142 randomised • Study duration: initiated in August 2016 • Study follow-up: not stated
Participants	• Country: Germany • Setting: Community • Kidney transplant recipients • Number: 148 (numbers per group not reported) • Mean age ± SD (years): 46 ± 12 • Sex: not described • Medium time after transplantation 5.2 years (range 3.0 to 9.8) • Exclusion criteria: not described
Interventions	• Intervention type classification: reminder • eHealth intervention used: mobile phone application Intervention group • Smartphone-based application supporting medication adherence Control group • Not reported
Outcomes	• Medication adherence (MMAS-8) • Knowledge about own medication
Notes	• 3 abstracts available; results only report characteristics and correlation with number of medications, medication adherence – no data regarding the difference between intervention and control participants • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported

Halleck 2017 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not be blinded given the nature of this intervention
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Objective outcome	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Unclear how knowledge will be assessed, MMAS is a self-reported measure of adherence so at high risk of bias
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Han 2016

Methods	• Study design: parallel RCT • Study duration: 6 months • Study follow-up: not reported
Participants	• Country: Korea • Setting: community • Kidney transplant recipients, at least 12 months post transplant • Number: 124; numbers per group not reported • Mean age ± SD (years): not reported • Sex (M): 36.2% • Exclusion criteria: not reported
Interventions	• Intervention type classification: reminder • eHealth intervention used: mobile phone application Intervention group • Mobile phone application * Internet-based application for androids provided alarm reminders at the time of dosing, provided data logs and medication information (e.g. dosages, adverse effects, toxicities) Control group

Han 2016 *(Continued)*

	• Not reported
Outcomes	Primary outcome is medication adherence • Proportion of patients with adequate adherence (> 80% of prescribed doses) - measured by Medication Event Monitoring System (MEMS) • Self-reported surveys of medication adherence: Basel Assessment of Adherence to Immunosuppressive Medications Scale (BAASIS) • VAS
Notes	• Abstract reporting preliminary results only • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Unlikely could be blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	objective adherence measurement, MEMS
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Self-reported medication adherence
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Preliminary data only
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement, preliminary data
Other bias	Unclear risk	Insufficient information to permit judgement, preliminary data

Hardstaff 2002

Methods	• Study design: parallel RCT; 100 randomised • Study duration: 12 months • Study follow-up: 12 months

Hardstaff 2002 *(Continued)*

Participants	• Country: UK • Setting: community • Kidney transplant recipients • Number (randomised/analysed): intervention group (75/67); control group (25/24) • Mean age ± SD (years): not reported • Sex (M/F): not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: clinical decision-aid
	• eHealth intervention used: PDA application
	
	Intervention group
	
	• Smart Top
	  * Medicine bottles with a microprocessor in the cap that records the date and time on each occasion the bottle is opened and closed
	  * This information can then be downloaded onto a computer data base via a special modem at their regular outpatient visits
	  * Patients bring bottles to quarterly (regular) outpatient appointments for downloading of information. Medications monitored were prednisone/azathioprine
	  * Participants also grouped into receiving feedback at outpatient appointment or no feedback regarding adherence
	
	Control group
	
	• Plain top bottle
	  * Received regular interviews by a nurse practitioner and pill counts to assess their compliance

Outcomes	Primary outcome • Medication adherence (% missed doses, consecutive missed doses, extra doses)
Notes	• Unclear whether 2 papers were the same study, but this was assumed given time frame and similar baseline numbers • High loss to follow-up at 12 months • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Intervention Feedback group received feedback at first outpatient appointment, therefore could not have been blinded

Hardstaff 2002 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Adherence downloaded from smart top lid - objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	High risk	10% loss to follow-up at 3 months, 36% loss to follow-up at 12 months
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	This study was performed on willing volunteers who most likely represented our more compliant patients. The data available included patients who, on the whole, remembered to bring the bottles to clinic and also returned the bottles at the end of the study. The outstanding data are on the remaining patients who have not returned the bottles because they kept forgetting to bring them and so are likely to represent the less compliant patients in this cohort

Henriksson 2016

Methods	• Study design: parallel RCT; 90 assessed for eligibility, 80 randomised • Study duration: 12 months • Study follow-up: 12 months
Participants	• Country: Sweden • Setting: community • Kidney transplant recipients, 7-14 days post transplantation • Number: intervention group (40); control group (40) • Mean age, range (years): intervention group (44.3, 9 to 68); control group (45.0, 2 to 69) • Sex (M/F): intervention group (25/15); control group (27/13) • Exclusion criteria: could not provide informed consent

Interventions	• Intervention type classification: reminder
	• eHealth intervention used: blue-tooth, electronic monitors
	
	Intervention group
	
	• Electronic monitoring drug dispensary
	  * At the prescribed time for taking the medication, the EMD gave visual and audible signals. If the patient did not take their medication, the audible signal was repeated with increasing frequency for 120 minutes.
	  * After this (or after the medication was taken), the EMD sent an SMS message to the web-based software, thus providing information about patient compliance.
	
	Control group
	
	• Standard care: no description

Outcomes	Outcomes measured at baseline and 10 clinic visits over 12 months Primary outcome

Henriksson 2016 *(Continued)*

	• Medication compliance to immunosuppressive medications (defined as taking compliance, dosing compliance, variability of dosing intervals, and number of drug holidays). Not assessed in standard care group Secondary outcomes (obtained from patient charts) • Outpatient follow up visits • ED readmissions • Information about biopsies • Rejection episodes • Rejection treatment • Kidney function (SCr) • blood concentrations of immunosuppressive medications
Notes	• Funding source: " The study was funded by grants from Roche AB and Tele2 Sverige AB. The project has been awarded grants from the Lennart Jacobsson Foundation, the Stig and Gunborg Westman Foundation, and the Paul Frankenius Foundation"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote "patients were randomized to intervention or control using prenumbered, sealed, and opaque envelopes in four batches (20 per batch)"
Allocation concealment (selection bias)	Low risk	Quote: "Each envelope randomly contained a note allocating the patient to either control or intervention. The randomization envelopes were assigned to the enrolled patients in consecutive order (1-80)"
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	No mention of blinding, other than statistician was blinded
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	The data were obtained from patient charts and the web-based software according to the study plan, over 10 visits in 1 year, by 2 of the investigators. All outcomes were objective.
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Low risk	Of all scheduled outpatient follow-up visits during the 1-year period (22 visits/patient), 6 participants missed a total of 11 visits (1%). There was no significant difference between the intervention and control groups.
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

iChoose 2016

Methods	• Study design: parallel RCT • Study duration: December 2014 to October 2015 • Study follow-up: 12 months
Participants	• Country: USA • Setting: outpatient clinic (3 sites) • ESKD patients for kidney transplant evaluation; 18- 70 years of age; no previous solid or multi-organ transplant; English-speaking; no severe cognitive or visual impairment • Number: intervention group (226); control group (217) • Mean age ± SD (years): intervention group (51.1 ± 9.9); control group (50.1 ± 10.3) • Sex (M): intervention group (63.3%); control group (61.8%) • Exclusion criteria: not reported
Interventions	• Intervention type classification: clinical decision-aid • eHealth intervention used: Website, internet Intervention group • iChoose clinical decision aid * Provides risk estimate of patient survival on dialysis versus kidney transplantation, and living vs deceased donor transplants to improve patients knowledge Control group • Usual care: Quote "center-specific transplant education was not identical, with one center requiring patients to attend a group transplant education session led by a transplant surgeon. However, patients at all sites received printed transplant education materials with similar content, including risks and benefits of transplant and financial and social support"
Outcomes	Primary outcome • Knowledge using a 9-item scale developed by a multidisciplinary group of transplant nephrologists, surgeons, behavioural scientists, and patients that was included in the patient baseline and follow-up surveys; scale not validated
Notes	• Funding source: Norman S. Coplon Satellite Healthcare Foundation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "research assistants obtained informed consent and randomized patients 1:1 with a random number generator application via iPad to receive center-specific standard of care education about kidney transplant with (intervention) or without (control) supplemental use of iChoose Kidney"
Allocation concealment (selection bias)	Unclear risk	Quote: "via iPad"
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Quote: "neither patients nor providers were blinded to the study group assignment"

iChoose 2016 *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Quote: "neither patients nor providers were blinded to the study group assignment"
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Quote: "Transplant knowledge was measured using a nine-item scale developed by a multidisciplinary group of transplant nephrologists, surgeons, behavioral scientists, and patients that was included in the patient baseline and follow- up surveys"
Incomplete outcome data (attrition bias) All outcomes	Low risk	Nil loss to follow-up; follow-up is only 1 clinic appointment
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

iDiD 2016

Methods	• Study design: parallel feasibility RCT); 182 screened, 60 eligible, 25 randomised • Study duration: 12 weeks • Follow-up duration: 12 weeks
Participants	• Country: UK • Setting: community • ESKD patients on maintenance HD; aged ≥ 18 years, who have mild to moderately severe depressive symptoms and/or presence of mild to moderately severe anxiety symptoms; speak English sufficiently well to engage with screening tools; they have a basic understanding of how to use the internet and an email address • Number: intervention group (18); control group (7) • Mean age ± SD (years): intervention group (49 ± 11.44); control group (47 ± 14.25) • Sex (M/F): intervention group (10/8); control group (5/2) • Exclusion criteria: individuals with severe depression (PHQ-9 score ≥ 20) and/or anxiety (GAD7 score ≥ 15); individuals with evidence of current suicidal ideation are considered inappropriate for iDiD online CBT

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: website, internet and Telehealth
	
	Intervention group
	
	• Online CBT
	  * Participants had access to the online CBT website
	• Therapist support
	  * Participants received three 30 min telephone support calls at weeks 2, 4 and 6. Telephone support was delivered by a trained psychological well-being practitioner
	  * The purpose of the telephone support calls was to promote engagement with the website and to support the patient in collaboratively developing goals to work on using the resources and information available to them on the website

iDiD 2016 *(Continued)*

	• Usual renal care Control group • Online CBT • Usual renal care * Attending for HD three times per week. Whilst attending for dialysis patients may encounter multidisciplinary renal team members. Contact with the renal psychologist only occurs if a patient is referred or self-refers for treatment. Participants will be advised in the participant information sheet to logon to the website once a week. iDiD targets specific cognitive, emotional, and behavioural mechanisms associated with psychological distress in HD. Participants will also receive weekly reminder emails to encourage engagement with the website. iPads will be available for participants to use during their dialysis sessions

Outcomes	Primary outcome
	
	• Feasibility and acceptability
	  * Descriptive statistics on recruitment and retention rates were collected
	  * Adherence to online psychotherapy sessions and therapist support calls, including number of completed calls and duration were recorded
	
	Secondary outcomes (baseline, 12 weeks)
	
	• Depression measured using the PHQ-9
	• Anxiety measured using GAD-7
	• QoL, measured using EuroQoL scale (EQ-5D)
	• ESKD illness perceptions, assessed using 8 item Brief Illness Perception Questionnaire
	• Health service utilisation, assessed using the Client Service Receipt Inventory combined with appropriate unit cost information
	• Treatments for depression and anxiety
	• Satisfaction
	• Serious adverse events

Notes	• Protocol deviations occurred in both trial arms. It was necessary to generate an email address and provide brief internet education for six patients (24% of consented sample; supported arm (5), unsupported arm (1)), thus these patients received a higher degree of technical support and face-to-face contact. One patient in the supported arm was unable to receive therapist calls because of their intensive home-care program (e.g. carers present) and associated multi-morbidity, therefore on-dialysis support was provided for this patient • A nested qualitative study will evaluate patient experience • Funding source: Guy's and St Thomas' charity (GSTT, grant number: EFT130206)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Automated random number generator with a 1:1 ratio was used
Allocation concealment (selection bias)	Low risk	The patient was informed of their group allocation via the online CBT program. The allocation sequence remained concealed from the trial coordinator and psychological therapists/supervisors
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants were informed of their allocation

iDiD 2016 *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Blinding likely would have been broken for some participants as it was necessary for the research team to complete follow-up measures with some patients.
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Measures of feasibility were objective and less likely to be biased
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Validated tools to measure self-reported depression and anxiety used. Participants were asked to complete themselves, however some participants required assistance from research personnel which may have led to bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	For primary outcome analyses 92% of participants completed follow-up data, no detail as to which group had loss to follow up.
Selective reporting (reporting bias)	High risk	Satisfaction, serious adverse events and treatments for depression and anxiety were not reported
Other bias	High risk	Did not meet sample size requirement (66), randomisation of 1:1 was not achieved with no explanation why deviated from this

InformMe 2017

Methods	• Study design: RCT, post-test-only control group design; 593 assessed for eligibility, 288 randomised • Study duration: October 2013 to December 2014 (site 1); January 2014 to July 2014 (site 2) • Study follow-up: 1 week
Participants	• Country: USA • Setting: outpatient clinic • Kidney transplant candidates; aged ≥ 21 years, English speaking, never received a kidney from an IRD, never, rarely, or sometimes need help with written information; willingness to use an iPad 2 tablet • Number: intervention group (133); control group (155) • Mean age ± SD (years): intervention group (51.2 ± 11.3); control group (50.5 ± 12.3) • Sex (M): intervention group (61.1%); control group (62.6%) • Exclusion criteria: not reported

Interventions	• Intervention type classification: education
	• eHealth intervention used: PDA application
	
	Intervention group
	
	• Inform Me
	  * iPad app to improve knowledge about increased risk donor kidneys
	  * Using computer adaptive learning method to personalise educational materials and content according to each participants' comprehension level in 5 interactive chapters
	  * At the end of each chapter questions to test knowledge with additional education provided if needed
	  * Summary reports generated
	• Routine transplant education and clinician visits
	
	Control group

InformMe 2017 *(Continued)*

	• Usual care * Routine transplant education and clinician visits
Outcomes	• Knowledge of IRD kidneys 31-item multiple choice test • Willingness to accept hypothetical IRD kidney (5 point Likert scale) • Acceptability (open ended questions)
Notes	• Funding source: "This publication was supported by the NINR/NLM (R21NR013660 to E.J.G.)"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using a computer-generated random number list
Allocation concealment (selection bias)	Low risk	Sealed envelopes concealed until study arm was assigned
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Trial was single blinded; research team members assessing outcomes were blinded to assignments to the intervention
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Outcomes were subjective and administered by research personnel who could have been made aware of allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	18 people dropped out with no significant differences between them and those who did not drop out but data not shown
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Provided with financial incentives, higher drop-out/refusal in intervention group; met sample size goal

Ishani 2016

Methods	• Study design: parallel RCT (3:1 randomisation); 4105 eligible, 601 randomised • Study duration: March 2012 to November 2013 • Study follow-up: 12 months
Participants	• Country: USA • Setting: community

Ishani 2016 *(Continued)*

- CKD (eGFR < 60 mL/min)
- Number: intervention group (450); control group (150)
- Mean age ± SD (years): intervention group (75.3 ± 8.1); control group (74.3 ± 8.1)
- Sex (M): intervention group (98.7%); control group (98.0%)
- Exclusion criteria: unable to give consent; had life expectancy less than 1 year; lived in a skilled nursing facility; had a primary care provider unwilling to allow participation

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention group
	
	• Telehealth
	  * Video monitoring device with peripherals and broadband installed in home and participants trained to use device and peripherals (BP cuff, scale, glucometer, pulse oximeter, stethoscope, web camera) and how to contact team
	  * Interprofessional team (nephrologists, nurse practitioner, clinical pharmacy specialist, psychologist, social worker, Telehealth care technician, dietitian) reviewed patient and developed patient-specific treatment plan addressing short and long term goals.
	  * Specific issues addressed included management of BP, volume status, proteinuria, DM, lipid levels, depression, HL, patient activation, lifestyle modification (physical activity, diet, weight reduction, smoking cessation) Education delivered over broadband device.
	  * Patients could interact with learning modules at their own pace.
	  * Vital signs automatically measured by device and transmitted to study team reviewed every 30 days by health team, Reviewed by study team every 3 months
	
	Control group
	
	• Usual care
	  * Invited to attend CKD education class and to follow primary care providers regarding kidney disease management
	  * Exact care not investigated

Outcomes	Primary outcome (measured at 12 months) • Composite of death, hospitalisation, ED visits and admission to skilled nursing facility Secondary outcomes (measured at 12 months) • Incidence of ESKD • Death • Hospitalisation (rate and length of 1st admission) • ED visits • Admission to skilled nursing facility Intermediate study outcomes (measured at 12 months) • SBP • LDL cholesterol • HbA1c
Notes	• Systolic BP higher in intervention at baseline, racial differences between groups at baseline

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomly assigned to receive the intervention or usual care using a centralized computer-generated randomization scheme using permuted

Ishani 2016 *(Continued)*

		block sizes of 2, 4, or 6. Randomization was stratified by eGFR (<30 vs >30 mL/min/1.73 m^2), presence of diabetes, and occurrence of a hospitalization in the past year"
Allocation concealment (selection bias)	Low risk	Quote: "Randomization occurred over the telephone by an individual blinded to patient identity"
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Likely blinding would have been broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Outcome assessors were blinded. all outcomes were objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Low risk	Only 1 participant (of 601) withdrew consent; used intention-to-treat analyses
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	baseline characteristics between groups similar, limited generalisability possible due to high proportion of men, met sample size calculation for power

Jammalamadaka 2015

Methods	• Study design: RCT; pre- and post-intervention study; 40 randomised, 27 reported • Study duration: 7 days • Study follow-up:
Participants	• Country: USA • Setting: community, dialysis unit • Maintenance HD with phosphate > 5.5 mg/dL for 2 or last 3 months • Number (randomised/received intervention): intervention group (20/13); control group (20/14) • Mean age ± SD (years): intervention group (48), control group (62) • Sex (M): 80% • Exclusion criteria: not reported
Interventions	• Intervention type classification: reminders • eHealth intervention used: Mobile phone text messaging Intervention group • Mobile phone text message reminders * Received text message reminders to take PO4 binders at meal times

Jammalamadaka 2015 *(Continued)*

	Control group • Usual care: not reported
Outcomes	• Serum phosphate (measured at baseline and 7 days)
Notes	• Contacted author re: participant demographics, randomisation strategy and blinding • Abstract-only publication

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Abstract stated "randomised", author contacted and said "we did not randomise"
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Author contacted - "both participants and personnel were blinded to the strategy" however participants would have known whether receiving text message reminders
Blinding of participants and personnel (performance bias) Blinding of personnel	Low risk	Author contacted - "both participants and personnel were blinded to the strategy", as intervention only 1 week blinding may have been upheld
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Serum phosphate
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Low risk	author quote: "no loss to follow-up"
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Small sample size, short study duration and follow-up, unlikely to change primary outcome in 7 days, intervention participants younger than control

Kargar Jahromi 2016

Methods	• Study design: parallel RCT; 60 randomised • Study duration: September to March 2014 • Study follow-up: 1 month (unclear)
Participants	• Country: Iran • Setting: community, dialysis unit • receiving maintenance HD

Kargar Jahromi 2016 *(Continued)*

- Number (randomised/completed): intervention group (30/27); control group (30/27)
- Mean age ± SD: 69.13 ± 11.82 years
- Sex (M): intervention group (44%); control group (60%)
- Exclusion criteria: history of serious or adverse experiences in the last six months; being treated with antidepressant medications; hospitalisation due to acute disease; unwillingness to continue to participate in the study

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention group
	
	• Telephone follow-up
	  * 30 days after dialysis shift (unclear how many phone calls participants received)
	  * Content of call follow script, consultations structured and contained key subjects: communication, cognition/development, breathing / circulation, nutrition, elimination, sleep, pain/ perception, skin / tissue, sexuality/reproduction, activity and psychosocial / spirituality / culture. 30 min conversation
	• Standard care
	
	Control group
	
	• Standard care: not reported

Outcomes	• Depression, anxiety and stress measured using validated tool DASS; measured at baseline and after intervention
Notes	• Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	"double blind" however participants could not have been blinded to their allocation
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	"double blind" researchers conducted the intervention unlikely they could have been blinded to a participants allocation Quote: "All interventions are conducted by the researcher responsible for this trial"
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	DASS completed before intervention was carried out and then after whilst self-report this is a validated tool. No mention of whether research personnel present while people filling out.

Kargar Jahromi 2016 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Low loss to follow-up in both groups (10%)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Small sample size limiting generalizability

Koprucki 2010

Methods	• Study design: pilot RCT; 26 randomised, 19 completed study • Study duration: 4 months • Study follow-up: 4 months
Participants	• Country: USA • Setting: community, dialysis unit • Maintenance PD patients • Number (randomised/completed): intervention group (13/10); control group (13/9) • mean age ± SD: 51.7 ± 16.4 years • Sex (M/F): not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: PDA application
	
	Intervention group
	
	• PDA
	  * Individualized PDA-assisted dietary adherence enhancement program based on Social Cognitive Theory to reduce sodium intake
	  * Monitored dietary intake with a PDA programmed with their dietary prescription and received PDA feedback regarding % of daily targets consumed and counselling based on Social Cognitive Theory
	• Computer-based dietary education
	
	Control group
	
	• Computer-based dietary education

Outcomes	Outcome measures taken at baseline and 4 months • Dietary sodium intake • BP • PD dietary problems questionnaire • Participation in intervention (number of meals entered into system)
Notes	• Abstract-only publication • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement

Koprucki 2010 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Unlikely could have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures low risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Insufficient information to permit judgement on who administered subjective measures
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Small sample size

Kullgren 2015

Methods	• Study design: RCT; 40 eligible, 32 randomised • Study duration: 4 weeks • Study follow-up: 4 weeks
Participants	• Country: USA • Setting: community • Paediatric transplant recipients • Number: intervention group (16); control group (16) • Mean age ± SD (years): 13.8± 5.4 years • Sex (F): 44% • Exclusion criteria: family did not speak English or if the child's cognitive functioning would interfere with their ability to participate
Interventions	• Intervention type classification: self-monitoring • eHealth intervention used: blue-tooth, electronic monitor Intervention group

Kullgren 2015 *(Continued)*

	• Interactive water bottle
	  * Recall fluid intake for 3 days prior to commencement of study via a log and to keep daily diaries
	  * Calculates personal hydration needs, tracks real time fluid intake pacing throughout the day.
	  * Participant enters weight and bottle automatically calculates fluid requirements, this can be adjusted manually.
	  * HydraCoach prompts user to drink by continuously visually displaying% consumed in litres or ounces
	• Standard care
	
	Control group
	
	• Standard care
	  * Recall fluid intake for 3 days prior to commencement of study via a log and to keep daily diaries
	  * Given written information regarding fluid target and choices.

Outcomes	Outcome measures assessed at baseline and 1 month • Fluid intake (Self-reported - reported intake, fluid goal achieved, fluid intake tracking - diary) • Biochemistry (BUN, sodium, creatinine - % change over the study period)
Notes	• Funding source: St. Louis Children's Hospital Nursing Research Grant and the University of Michigan Charles Woodson Fund for Clinical Research

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Blinding not possible
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	No reporting of blinding of personnel
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Biochemical measures of creatinine, BUN and sodium are objective
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Self-reported measure
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No reported loss to follow up or incomplete diaries
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement

Kullgren 2015 *(Continued)*

Other bias	High risk	small sample size - population not generalisable, limited follow-up time, control and intervention groups significantly different with respect to time since transplant, low uptake rate of the intervention

Li 2014b

Methods	• Study design: RCT; 186 assessed for eligibility,160 participants randomised • Study duration: 6 weeks • Study follow-up: 12 weeks
Participants	• Country: China • Setting: community, dialysis unit • Maintenance PD patients • Number (randomised/completed): intervention group (80/69); control group (80/66) • Mean age ± SD (years): intervention group (57.4 ± 12.8); control group (55.2 ± 11.9) • Sex (M/F): intervention group (42/27); control group (37/29) • Exclusion criteria: Tenchkoff catheters in situ for less than 3 months; receiving intermittent PD or HD and those with planned admissions for special treatment procedures; psychosis or dementia; dying or unable to communicate; being transferred to another unit during their hospital stay

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention group
	
	• Telephone support
	  * Comprehensive discharge planning protocol prior to discharge and standardised 6-week post-discharge nurse-led telephone support intervention
	  * Patients physical, social, cognitive and emotional needs assessed and comprehensively and individualised education program conducted prior to discharge
	  * After discharge nurse case managers began telephone contact with patients weekly for 6 consecutive weeks. First call within first 72 hours after discharge to assess status and give advice
	  * Content of each telephone call guided by the protocol and specific problems identified in predischarge assessment
	  * Case manager discussed issues patients encountered and if necessary made appropriate referrals
	
	Control group
	
	• Standard care
	  * Talking to doctor about special points that need attention when returning home
	  * Telephone hotline service
	  * Set of free self-help printed materials on maintaining healthy lifestyle
	  * Reminder to attend outpatient appointments

Outcomes	• QoL: KDQoL-SF (baseline, 6 weeks, 12 weeks) • Complications (oedema, weight gain, peritonitis, catheter infections, biochemistry (urea, creatinine, sodium, K, PO_4, albumin), self reported and validated against hospital records (measured weeks 6-12) • Healthcare utilisation: self reported and hospital records (days between index discharge and readmission were extracted from the hospital information systems) (measured weeks 6-12)
Notes	• Funding source: "partly supported by Outstanding young talents training project of Guangdong Province (Grant No. LYM11035) and the Guangdong Natural Science Foundation, China (Grant No. S2011040005590)"

Li 2014b *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer generated numbers
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Unable to be blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	No mention but probably not blinded because of nature of intervention
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Hospital records are objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of whether blinded, some measures (QoL) used validated measures, while others (health service utilisation) was self-reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Dropout (13.7% to 17.5%), no mention of whether these drop outs significantly different; only those with full outcome data included in study; reasons for drop outs similar across both groups
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement
Other bias	High risk	Small sample size, short duration - not generalisable under powered

McGillicuddy 2013

Methods	• Study design: proof-of-concept RCT; 41 assessed for eligibility, 21 randomised • Study duration: 3 months • Study follow-up:3 months
Participants	• Country: USA • Setting: community • Kidney transplant recipients with adherence score of < 0.85 • Number (randomised/analysed): intervention group (11/9); control group (10/10) • Mean age ± SD (years): intervention group (42.44 ± 12.04); control group (57.6 ± 8.28) • Sex (M): intervention group (44%); control group (70%) • Exclusion criteria: inability to self-administer medications; inability to measure own BP; inability to use a mobile phone; history of psychiatric illness or substance abuse; pregnant, lactating or intention of becoming pregnant during the trial; participant in another study; inabilities to speak, hear, or understand English; poor cellular coverage in their home
Interventions	• Intervention type classification: reminders

McGillicuddy 2013 *(Continued)*

	• eHealth intervention used: Blue-tooth, electronic monitoring
	
	Intervention group
	
	• Wireless electronic medication tray with wireless Bluetooth BP monitor and a smart phone
	  * At prescribed dosing day and time a blinking light from specific dose compartment is activated. If after 30 min compartment not opened, removed and returned a loud chime auto activated 30 min. If still not opened auto reminder phone call or text message delivered to participant
	  * Failure to open after 90 min auto generates text message or email to study co-ordinator.
	  * Participants sent text messages every 3 days to remind to test BP. BP readings auto sent via Blue-tooth to mobile phone and from there via cellular network to data repository
	  * Patients contacted when indicated med non-adherence, failure to measure BP, BP outside thresh-old ranges. If BP outside threshold study co-ordinator contacted for repeat measures, if continue then physician contacted who made changes to medications
	
	Control group
	
	• Usual care
	  * Clinic visit every 4-6/52 and post-transplant education and 24 hour phone availability

Outcomes	Outcomes measured baseline, month 1, month 2, month 3 • Adherence: adherence score - 0, 0.25, 0.5, 0.75, 1 based on timing medication taken compared to pre-scribed time • BP: seated upright with right arm resting on table at heart level; reading immediately taken and after 5 min rest 2 additional readings taken separated by 2 min interval. Average of the last 2 readings used in analyses
Notes	• Funding source: "supported by the South Carolina Clinical & Translational Research Institute, with an academic home at the Medical University of South Carolina, CTSA NIH/NCRR, Grant no. ULIRR029882 and funding from the Duke Endowment and the Verizon Foundation"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence genera-tion (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (perfor-mance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (perfor-mance bias) Blinding of personnel	High risk	No mention of which personnel involved. non adherent messages etc were sent to the study coordinator
Blinding of outcome as-sessment (detection bias) Objective outcome	Low risk	Objective measures (SBP) are at low risk of bias
Blinding of outcome as-sessment (detection bias) Subjective outcomes	High risk	Participants self reported this outcome and were not blinded

McGillicuddy 2013 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Before randomisation quite high dropout but after only one person dropped out of the intervention group because the clinic schedule was incompatible for the patient to continue. The researchers were aiming to get 20 participants and achieved this
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Small sample not likely generalisable randomisation of intervention and control results in sig diff in age and adherence which questions the validity of conclusions. could not participant in the study if they did not have strong cellular signal at their house. This may skew the data against rural participants, or those who are more time poor

MESMI 2010

Methods	• Study design: parallel RCT; 1389 assessed for eligibility, 80 randomised • Study duration: 3 months • Study follow-up: 9 months
Participants	• Country: Australia • Setting: community • CKD patients (< 60 mL/min) and diabetes • Number (randomised/analysed): intervention group (39/36); control group (41/39) • Mean age ± SD (years): intervention group (68 ± 8.3); control group (66 ± 10.8) • Sex (M): intervention group (56.4%); control group (56.1%) • Exclusion criteria: < 18 years; didn't comprehend English; not mentally competent; didn't have type 1 or 2 diabetes and CKD estimated by a MDRD eGFR > 15 (≤ 60 mL/min/1.73 m^2) or diabetic kidney disease (microalbumin/creatinine ratios > 2.0 mg/mmol for men, > 3.5 mg/mmol for women), and systolic hypertension ≥ 130 mmHg treated with prescribed antihypertensive medication; live more than 50km from the city centre; pregnant; had received a new diagnosis of cancer

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth, DVD
	
	Intervention group
	
	• MEMSI
	  * self-monitoring BP, individualised med review
	  * 20 min DVD
	  * fortnightly follow up telephone contact for 12 weeks.
	  * delivered by renal specialist nurse with doctoral qualifications trained in motivational interviewing using a checklist and standing scripts for fidelity
	
	Control group
	
	• Usual appointment schedule

Outcomes	Outcomes measured at 0, 3, 6 and 9 months post intervention • SBP • Medication adherence: measured using pill counts, Morisky's medication adherence scale, Medication adherence self-efficacy scale and using surrogate biochemical parameters (eGFR, urine ACR, serum creatinine, Hb, HbA1c, $CaPO_4$. LDL-cholesterol)

MESMI 2010 *(Continued)*

	• QoL - SF12 • Health care utilisation (unclear how this was measured) • Feasibility: attrition, participation in all aspects of care, satisfaction
Notes	• Funding source: " supported by an Australian Research Council (Linkage) Grant (LP0774989), Sigma Theta Tau International Small Grant, Nurses Memorial Centre Australian Legion of Ex- Servicemen and Women Scholarship, and the Mona Menzies Nurses Board of Victoria Grant"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified block randomisation
Allocation concealment (selection bias)	Low risk	Identity kept in locked cabinet and research assistant blinded to allocation
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Low risk	Research assistant blinded and participants asked not to discuss their allocation with research assistant when measures taken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Adherence (Morisky's, pill count, SF-12 - validated, serum levels, BP)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	QoL, self-efficacy
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 5% lost to follow up
Selective reporting (reporting bias)	High risk	No reporting of QoL (SF12), medication adherence self-efficacy scale or health care utilisation in paper as were outlined in protocol
Other bias	Unclear risk	Study was under powered

Navaneethan 2017

Methods	• Study design: parallel RCT; 485 assessed for eligibility, 209 randomised • Study duration: July 2012 to December 2013 • Study follow-up: 2 years
Participants	• Country: USA • Setting: community • English-speaking adults aged 18–80 years with an eGFR 15–45 mL/min/1.73 m^2 • Number: intervention group (50); control group (57)

Navaneethan 2017 *(Continued)*

- Median age; IQR (years): intervention group (67; 61, 72); control group (68; 64, 72)
- Sex (F): intervention group (50%); control group (68%)
- Exclusion criteria: kidney transplant recipients; patients on dialysis, patients with terminal illness or cancer

Interventions	• Intervention type classification: self-monitoring, behavioural counselling and self-monitoring with education
	• eHealth intervention used: Internet, website
	
	Intervention group
	
	• Enhanced personal health records (self-monitoring and education)
	  * The E-PHR functionality was developed with the assistance of Cleveland Clinic's Information Technology Division MyChart team to securely review CKD education materials. These features were in addition to the existing features available to all PHR users.
	  * CKD alert appeared only once, and when the patient clicked on the alert, it led them to the page that provided details for CKD. Educational resources were adapted from local and national resources, including education materials covering topics like nutrition and physical activity, complications of CKD, co-morbidity management and planning for dialysis.
	
	Control group
	
	• Usual care (self-monitoring)
	  * Advised to use their PHR (MyChart account via EPIC [Madison,WI]) accounts to aid in the management of their health. No specific changes to their PHR accounts were made.
	  * All patients who use the PHR can review and schedule appointments, request prescription renewals, view health summaries, access a current list of medications, review test results, and send a secure message to their physicians or health care team. Patients also receive automated important health reminders on the basis of sex- and age-based health maintenance schedules as well as chronic disease–related reminders.
	  * Links within the PHR allow patients to access reliable health information about a broad range of topics of personal interest through a third-party vendor (MedlinePlus).

Outcomes	Primary outcome Change in eGFR Secondary outcomes • Acquisition of appropriate laboratory measures: Hb, phosphorus, UACR, 25-hydroxy vitamin D, PTH, LDL-cholesterol, HbA1c • Prescription of renoprotective medications (i.e. ACEi and ARB) • Referral rates to nephrologists, vascular surgeons and for kidney transplantation assessment • Achieving BP control, < 130/80 mmHg • Number of hospitalisations and ED visits • Death
Notes	• 75% of study populations were white • Funding source: "This clinical trial was supported by grant R34DK094112 from the National Institutes of Health (NIH), National Institute of Diabetes and Digestive and Kidney Diseases. The creation of the Cleveland Clinic CKD registry was funded by an unrestricted grant from Amgen, Inc. (to the Department of Nephrology and Hypertension Research and Education Fund, Cleveland Clinic)"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation scheme that was stratified by family health centre

Navaneethan 2017 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Quote: "Randomization allocation was concealed" however not detail on how this was achieved
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Quote: "Participants were aware of their assignment"
Blinding of participants and personnel (performance bias) Blinding of personnel	Low risk	Quote: "Study personnel (study coordinator and the navigators) were aware of their assignment, but the outcome assessors were not aware of the study assignments".
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	All outcomes are objective and at low risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective measures being used
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up
Selective reporting (reporting bias)	Low risk	All stated outcomes have been reported
Other bias	High risk	"We did not power the study specifically to estimate the interaction of the two interventions"

Ong 2017

Methods	• Study design: parallel RCT; 182 enrolled and randomised, 157 completed 6 month assessment • Study duration: 12 months • Study follow-up: preliminary 6 month data reported only
Participants	• Country: Canada • Setting: community • CKD stage 3B-5 to dialysis-dependent • Number (randomised): intervention group (89); control group (93) • Mean age ± SD (years): not reported • Sex: not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: mobile phone application
	
	Intervention group
	
	• eKidneyCare
	  * Integrated mobile app allowing patients to monitor blood pressure, manage medications, assess symptoms, review laboratory results
	  * Real time patient feedback
	  * Real time provider alerts

Ong 2017 *(Continued)*

	Control group
	• MyMedRecord
	  * Commercially available app that records medical information
	  * No feedback

Outcomes	Primary outcomes (measured at baseline, 6 months, 12 months) • SBP • DBP
Notes	• Preliminary abstract-only publication; 6 month results only • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Insufficient information to permit judgement, however unlikely as providers are given real time alerts
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	BP is objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective measures reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	25 withdrew due to incomplete data or due to medical complications; unclear which study group withdrawals were from
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Poorgholami 2016a

Methods	• Study design: parallel RCT; 75 assessed for eligibility, 75 randomised • Study duration: 2 months

Poorgholami 2016a *(Continued)*

	• Study follow-up: 2 months
Participants	• Country: Iran • Setting: community, dialysis centre • Receiving maintenance HD patients • Number: intervention group 1 (25); intervention group 2 (25); control group (25) • Mean age ± SD (years): intervention group 1 (50.92 ± 6.46); intervention group 2 (47.84 ± 8.65); control group (49.4 ± 6.04) • Sex (M): intervention group 1 (44%); intervention group 2 (60%); control group (60%) • Exclusion criteria: history of serious or adverse experiences in the last six months; treatment with antidepressant medications; hospitalisation due to acute disease; and unwillingness to participate or to continue with the study

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention groups
	
	• Intervention group 1: self-care education
	  * 5 consecutive one hour instructions about the disease process and symptoms as well as importance of HD, diet, fluid restriction, daily body weight control, physical activity, smoking cessation, stress management, muscular relaxation, and monitoring the vital signs
	  * Given a copy of an instruction booklet comprising a summary of material taught in the 5 instructional sessions
	• Intervention group 2: self-care education plus telephone support
	  * 5 consecutive one hour instructions about the disease process and symptoms as well as importance of haemodialysis, diet, fluid restriction, daily body weight control, physical activity, smoking cessation, stress management, muscular relaxation, and monitoring the vital signs
	  * Given a copy of an instruction booklet comprising a summary of material taught in the 5 instructional sessions.
	  * 3 telephone calls per week for the next two months following the instructions. The duration of each call was 20 minutes, which could also vary according to the patients' needs. The content of telephone conversations included issues, which had been taught in the five instructional sessions and had been mentioned in the booklet as well as answers to the patients' questions. In addition, the patients were told that they could call the investigator any time for their ad hoc questions.
	
	Control group
	
	• Routine care offered in the hospital

Outcomes	• Miller's questionnaire of hope (Conducted on day 56 after the study)
Notes	• Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Not possible due to nature of the intervention

Poorgholami 2016a *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Follow-up calls made by investigator or his assistant, likely blinding was not upheld
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	No objective outcomes were measured
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Completed in the dialysis ward, no mention of who gave out to patients. Valid questionnaire
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants included in analysis
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Potter 2016

Methods	• Study design: RCT, 89 solid organ transplant recipients randomised (46 kidney transplant recipients) • study duration: 3 years • Study follow-up: 3 years
Participants	• Country: USA • Setting: community • Kidney transplant recipients • Number: intervention group 1 (20); intervention group 2 (20); control group 1 (26); control group 2 (not reported) • Mean age ± SD (years): not reported • Sex (M/F): not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: reminders
	• eHealth intervention used: electronic monitoring device; SIMpill system captures medication adherence system. It communicates and stores the timing of openings and doses taken to a secure server
	
	Intervention groups
	
	• Intervention group 1
	  * SIMpill system plus reminders (email or text message reminders when medication doses missed)
	• Intervention group 2
	  * SIMpill system plus reminders plus healthcare provider feedback (if missed dose not taken with reminder alert)
	
	Control groups
	
	• Control group 1
	  * SIMpill system
	• Control group 2
	  * Not described

Potter 2016 *(Continued)*

Outcomes	• Number of biopsies performed • Biopsy proven rejection (% of group) • Length of stay for treatment (days) • Total doses taken (%) • Days with correct dosing (%)
Notes	• Preliminary data from 1 year presented • Only 4 abstracts available

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Blinding of participants would not be possible with this intervention
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Study personnel notified if missed medication doses in intervention group 2
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	All outcomes described are objective and less risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Only preliminary data is being reported
Selective reporting (reporting bias)	Unclear risk	Only preliminary data is being reported
Other bias	Unclear risk	Insufficient information to permit judgement as limited detail is able to be obtained from abstracts

Reese 2017

Methods	• Study design: parallel RCT (1:1:1); 376 assessed for eligibility, 120 randomised • Study duration: 6 months • Study follow-up: 6 months
Participants	• Country: USA • Setting: community

Reese 2017 *(Continued)*

- Kidney transplant recipients during the first 2 weeks after transplantation
- Number (randomised/analysed): intervention group 1 (40/40); intervention group 2 (40/39); control group (40/38)
- Mean age ± SD (years): intervention group 1 (50 ± 12); intervention group 2 (50 ± 11); control group (49 ± 11)
- Sex (M/F): intervention group 1 (25/15); intervention group 2 (23/17); control group (24/16)
- Exclusion criteria: inability to manage medications; poor English comprehension; HIV-positive serostatus; living more than 120 miles from the centre (because these patients return to local care soon after transplantation); and/or discharge to an acute-care facility

Interventions

- Intervention type classification: reminder and reminder plus education
- eHealth intervention used: blue-tooth, electronic monitor

Intervention group 1

- Wireless pill bottle: customised reminder
  * Each participant was provided with a wireless pill bottle (Vitality GlowCap; Vitality Inc) that recorded pill-cap openings; these data were transmitted in real time to the study database.
  * light on the bottle would illuminate and the cap would chime when the medication was due
  * Adherence data were transferred from the Vitality website to a web-based secure research platform called Way to Health
  * Participants could select additional reminders, including texts or telephone calls with recorded messages or e-mails with a weekly adherence summary
  * Each participant could change their intended times of taking medication and/or reminders

Intervention group 2

- Wireless pill bottle: customised reminder + provider feedback
  * Each participant was provided with a wireless pill bottle (Vitality GlowCap; Vitality Inc) that recorded pill-cap openings; these data were transmitted in real time to the study database.
  * light on the bottle would illuminate and the cap would chime when the medication was due
  * Adherence data were transferred from the Vitality website to a web-based secure research platform called Way to Health.
  * Participants could select additional reminders, including texts or telephone calls with recorded messages or e-mails with a weekly adherence summary.
  * Each participant could change their intended times of taking medication and/or reminders.
  * Every 2 weeks providers received notification if adherence fell below 90%

Control group

- Received a wireless pill bottle that provided no alerts and only tracked adherence.

Outcomes

Primary outcome

- Adherence (measured by pill bottle electronic records): adherence only measured in the final 90 days of the study (when clinic visits are less frequent)

Secondary outcomes

- Pill bottle–measured adherence between 14 days and the end of the study;
- Coefficient of variation of TAC blood concentrations (calculated within each participant)
- Coefficient of variation of any morning TAC blood concentration, measured for any indication
- Basel Assessment of Adherence to Immunosuppressive Medications Scale (BAASIS), a validated 5-item self-reported questionnaire specific to immunosuppression, administered at study end

Post hoc analysis

- Compared pill bottle–measured adherence with censoring of data when participants appeared to permanently discontinue pill bottle use

Reese 2017 *(Continued)*

	• Compared adherence in the final 6 weeks • Treated days when participants were hospitalised as fully adherent
Notes	• Funding source: "Leonard Davis Institute (LDI) at the University of Pennsylvania and additional support was provided by the LDI's Center for Health Incentives and Behavioral Economics"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded given the nature of the intervention
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Study coordinator contacted patients if adherence was below 90% in the feedback group, no mention of blinding of study coordinator for participants in other groups
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Post hoc analyses were conducted by blinded personnel, no mention of whether this also occurred for primary and secondary outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective outcomes were measured
Incomplete outcome data (attrition bias) All outcomes	Low risk	3/120 dropped out (2.5%)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Reilly-Spong 2015

Methods	• Study design: parallel RCT; 388 assessed for eligibility, 63 randomised • Study duration: January 2010 to March 2012 • Study follow-up: 6 months
Participants	• Country: USA • Setting: community • kidney transplant recipients aged ≥ 18 years • Number (randomised/analysed at 2 months/analysed at 6 months): intervention group 1 (31/24/20); intervention group 2 (232/27/22) • Mean age ± SD (years): intervention group 1 (52.6 ± 12.6); intervention group 2 (54.6 ± 11.7)

Reilly-Spong 2015 *(Continued)*

- Sex (M/F): intervention group 1 (8/19); intervention group 2 (16/12)
- Exclusion criteria: prior transplant, prior mindfulness-based stress reduction or regular meditation practice; serious mental health concerns (suicidality, psychotic disorder, or substance abuse identified on screening by a psychologist); hospitalised or medically unstable (e.g. recent stroke); kidney transplant scheduled within the next 3 months

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention group 1
	
	• Telephone-adapted mindfulness-based stress reduction
	  * Teleconferences used to deliver MBSR to make it more accessible for patients with ESKD.
	  * Received recordings or practices in teachers voice to use at home
	  * copy of "Full Catastrophe Living"
	  * workbook (course guide and an educational workbook)
	  * DVDs of "Mindful Movement and Stillness"
	  * In-person 5 hour workshops in weeks 1 and 8, separated by 90 min teleconferences in weeks 2-7. Overall 19 hours of class time
	
	Intervention group 2
	
	• Telephone-adapted support group
	• To provide attention from a facilitator, group support and structured study activities to balance treatment arms with respect to known non-specific effects of MBSR.
	• Provide content driven and highly structured intervention with an attentive instructor to elicit positive group experience and prevent lengthy or pervasively negative discussions of problems interpersonal communication skills and how to select health resources were selected as generic skills that would not overlap with MBSR
	• Skill building with homework assignments included Homework assignments designed by leader in weeks 1,6,7 but individual action commitments for other weeks.

Outcomes	Primary outcome (measured at baseline, 2 months, 6 months) • Anxiety (state-trait anxiety inventory STAI) Secondary outcomes (measured at baseline, 2 months, 6 months) • depression (centre for epidemiological studies - depression) • Insomnia (Pittsburgh Sleep Quality Index) • HRQoL (measured using SF-12: mental and physical component scores, pain interference item) • Mindfulness (mindful attention awareness scale) • Worry (Penn-state worry questionnaire) • Perceived stress (perceived stress scale PSS-14) • Fatigue PROMIS fatigue short form • 2 subscales from KDQoL (impact and burden) • Actigraphy (sleep quantity and quality - objective measure) • Salivary cortisol (objective biomarker or stress) Other outcome (measured at 2 months) • Feasibility and acceptability (Intervention attendance: roll call and recorded weekly rosters, conference call records provided by teleconference vendor; treatment preference and expectations of intervention usefulness assessed on health and attitudes questionnaires; treatment fidelity measured by tallies of prescribed course elements on intervention checklists with weekly calls and occasional live monitoring by health psychologist)

Reilly-Spong 2015 *(Continued)*

Notes	• Funding source: National Institute of Diabetes and Digestive and Kidney Diseases Award P01 DK013083 and National Center for Advancing Translational Sciences of the National Institutes of Health Award Number UL1TR00011

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer generated using permuted blocks
Allocation concealment (selection bias)	Low risk	conducted by statistician who was masked. participants completed baseline assessments prior to randomisation
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Quote: "single blind"
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Unlikely could have been blinded / blinding would have been broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures (salivary cortisol and sleep actigraphy)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Feasibility and acceptability measures taken with staff, QoL and anxiety measures are patient reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low loss to follow-up (12.5% to 12.9%)
Selective reporting (reporting bias)	High risk	Salivary cortisol and sleep actigraphy and a number of emotional state outcomes were not reported in either paper
Other bias	Unclear risk	Insufficient information to permit judgement

Rifkin 2013

Methods	• Study design: parallel RCT (with 2:1 randomisation); 336 assessed for eligibility, 47 randomised • Study duration: 6 months • Study follow-up: 6 months
Participants	• Country: USA • Setting: community • patients with CKD stage 3 or greater with uncontrolled hypertension • Number (randomised/completed and analysed): intervention group (30/28); control group (17/15) • Mean age ± SD (years): intervention group (68.5 ± 7.5); control group (67.9 ± 8.4) • Sex (M): intervention group (93%); control group (100%)

Rifkin 2013 *(Continued)*

	• Exclusion criteria: presence of a clear secondary cause for HTN (e.g. aldosterone producing tumour), or estimation by clinic physicians that the individual was within 6 months of requiring dialysis or of dying from other causes

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: Bluetooth, electronic monitors
	
	Intervention group
	
	• Tele-monitoring device paired with Bluetooth enabled BP cuff
	  * Device consisted of 2 integrated subunits: automatic oscillometric BP unit and home health hub.
	  * BP units have BP measuring range spread over 20-280 mmHg and pulse range 40-200 beats/min.
	  * Home Health Hub is 1x4x6 inch wall unit which participant plugged into any available outlet and leave there for study duration. It receives BP and pulse data through Bluetooth from the BP unit and relays data through internet (using study-provided cellular modem) to secure website, accessible to study personnel through password
	  * Website allows viewing of BP data sorted by participant using unique study ID numbers
	  * Participants educated about appropriate use of cuff prior to clinic appointments electronic medical record updated with full recording of tele-monitored results
	  * Study personnel met weekly to review BP logs, if participant consistently had above-goal readings during prior week one of personnel would ring to discuss. Additional urgent or clinic physician follow-up scheduled at discretion of team
	
	Control group
	
	• Usual care
	  * Asked to measure and record BP at home according to physicians instructions; no specifics about frequency

Outcomes	Outcomes measured at baseline and 6 months • change in BP (SBP and DBP) • MAP • kidney function (eGFR, SCr) • Medication adherence (Morisky's medication adherence scale) • Medication use (number of total medications, number of BP medications, number of medication changes) • Unplanned clinic communications • Acceptability (measured at end of study)
Notes	• Funding source: USCD Clinical/Translational Research Institute's Innovative Technology Pilot Grant (Grant UL RR031980 and UL1TR000100).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Odd/even is a simple randomisation technique which is considered to maintain randomness
Allocation concealment (selection bias)	Low risk	Used opaque envelopes
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded

Rifkin 2013 *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Study personnel contacted intervention participants when BP too high. study physicians and pharmacist met weekly re: BP logs
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Not blinded but objective measures
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Questionnaires were collected by the treating physicians (not the study physicians) however likely participants could have broken blinding. Self-report questionnaires about adherence by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	8.5% loss to follow-up (4 out of 47)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Small sample, short follow-up

Robinson 2014a

Methods	• Study design: parallel RCT; 601 assessed for eligibility, 103 participants randomised • Study duration: May 2013 to July 2013 • Study follow-up: 6 weeks
Participants	• Country: USA • Setting: community • Kidney transplant recipients • Number (randomised/analysed): intervention group (52/50); control group (51) • Mean age, range) (years): intervention group (54, 44 to 62); control group (54, 44 to 60) • Sex (M): intervention group (63%); control group (67%) • Exclusion criteria: prior history of skin cancer, as noted in the medical record or self-reported; a history of dermatologic disease treated with ultraviolet light, e.g., psoriasis, atopic dermatitis; under the care of a dermatologist within the last 5 years

Interventions	• Intervention type classification: Education plus reminders
	• eHealth intervention used: text message or email reminders
	
	Intervention group
	
	• Educational intervention plus text message/email reminders
	  * Sun protection workbook to take home
	  * series of automated electronic reminders sent via text message or email.
	  * Over period of 5 weeks, 3 seasonal sun protection reminders were sent by telephone text message or email (depending on patients preference)
	
	Control group
	
	• Standard care
	  * Educational intervention to be delivered in nephrologist/surgeon offices

Outcomes	Primary outcome measure (assessed at baseline and 6 weeks)

Robinson 2014a *(Continued)*

	• Sun protection behaviours (self-reported, validated tool) Secondary outcomes (assessed at baseline and 6 weeks) • Willingness to use sun protection (self-reported, validated tool) • Knowledge of skin cancer and sun protection (self-reported, validated tool) • Attitudes about developing skin cancer and personal risk (self-reported, validated tool) • Pigmentation – melanin index, taken using Mobile DataCollector DC3000 spectrophotometer AND clinical dermatologist assessment
Notes	• Funding source: supported by R03 CA-159083 to JKR, from the National Cancer Institute

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Randomization was performed using stratified random blocks using RCore Team (19), to assure equal allocation to groups over the accrual period, in total, as well as within ethnic/racial groups"
Allocation concealment (selection bias)	Low risk	Quote: "Sequentially blinded sealed envelopes were provided by the statistician to the study coordinator, to be opened by the participant after the baseline visit"
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Blinding not possible
Blinding of participants and personnel (performance bias) Blinding of personnel	Low risk	Biologic measures at baseline and 6 weeks assessed by research coordinator blinded to the study group
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures of pigmentation used
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Subjective measure of pigmentation from RAs who trained by dermatologist, used validated self-reported attitudes, knowledge and behaviour
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up (1)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Did not reach power calculation, small sample population; financial incentives provided

Robinson 2015

Methods	• Study design: RCT; 853 assessed for eligibility, 170 randomised • Study duration (recruitment): 30 May to 15 July 2014

Robinson 2015 *(Continued)*

	• Study follow-up: 6 weeks
Participants	• Country: USA • Setting: community • kidney transplant recipients • Number (randomised/completed): intervention group (84/78); control group (86/83) • Mean age ± SD (years): intervention group (51 ± 12.5); control group (49 ± 14.2) • Sex (M): intervention group (56%); control group (62%) • Exclusion criteria: history of skin cancer as self-reported or noted in their medical record; received education about sun protection or participated in our previous educational sun protection study; experienced kidney rejection; visually impaired; comorbid diseases prevented participation

Interventions	• Intervention type classification: Education plus reminders
	• eHealth intervention used: tablet application plus reminder emails or text messages
	
	Intervention group
	
	• Tablet app education
	  * Research team gave brief tutorials about how to use tablet
	  * Sun protection program delivered on personal tablet computers
	  * During the next 5 weeks, 2 reminders provided to intervention group as telephone calls, text messages or emails (depending on participant preference)
	
	Control group
	
	• Usual care
	  * 2-3 sentences in binder provided at time of transplantation surgery and during summer clinicians gave verbal reminders to wear sunscreen

Outcomes	Outcomes measured at baseline and 6 weeks • Sun protection behaviours (self-reported, validated tool) • Willingness to use sun protection (self-reported, validated tool) • Knowledge of skin cancer and sun protection (self-reported, validated tool) • Attitudes about developing skin cancer and personal risk (self-reported, validated tool) • Skin pigmentation (clinical dermatologist + trained research coordinators + spectrophotometer)
Notes	• Additional paper and abstract looking at Health Literacy sub-group analysis • Results stratified by ethnicity • Funding source: Supported by R21 CA-173196 to June K. Robinson, MD, from the National Cancer Institute

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified random blocks using R Core Team
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded

Robinson 2015 *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Research co-ordinators and dermatologist blinded, but may have been broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures of pigmentation used
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Validated self-reported measures of knowledge, behaviours and attitudes. research personnel assessing skin pigmentation were trained by a clinical dermatologist for the study blinded however this blinding may have been broken and RAs not dermatologists which may question accuracy of their assessment
Incomplete outcome data (attrition bias) All outcomes	Low risk	5% loss to follow-up (9/172)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Low participation rate - may not be representative; higher participation rates among white people; monetary incentives

Russell 2011

Methods	• Study design: pilot RCT; 40 assessed for eligibility, 15 randomised • Study duration: 6 months • Study follow-up: 6 months
Participants	• Country: USA • Setting: community • Kidney transplant recipients non-adherent prior to recruitment • Number (randomised/analysed): intervention group (8/8); control group (7/5) • Mean age ± SE (years): intervention group (55 ± 12.1); control group (44 ± 15.7) • Sex (M/F): intervention group (4/4); control group (3/4) • Exclusion criteria: participated in previous pilot study; < 18 years; received other organ (e.g. non kidney) transplant in addition to kidney transplant; receiving dialysis; unable to speak, hear or understand English; not able to open electronic medication cap; unable to self-administer medication; does not have access to a telephone; has cognitive impairment as determined by the Telephone Mental Status Screen; has a life-limiting diagnosis such as metastatic cancer; acutely unwell (e.g. hospitalised)

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: blue-tooth, electronic monitoring
	
	Intervention group
	
	• Electronic pill monitoring
	  * Medication Event Monitoring System where each cap contains battery and records date and time with each removal of the cap)
	  * Participant and nurse collaboratively identified life routines, important people and possible solutions to enhance medication taking
	  * Participant received individualised monthly medication taking feedback delivered by a graphic print out of daily medication taking generated from the electronic medication cap

Russell 2011 *(Continued)*

	Control group • Attention control * Provided with educational brochures and monthly phone calls to review education
Outcomes	Primary outcome (measured daily and assessed at baseline and 6 months) • Adherence was measured using electronic records from pill caps and with diaries to substantiate (objective and subjective). Adherence score - 0, 0.25, 0.5, 0.75, 1 based on timing medication taken compared to prescribed time. Secondary outcome (measured at 6 months) • Perception of burden (participants asked how burdensome interventions were - subjective)
Notes	• Funding source: grants from American Nephrology Nurses Association, National Kidney Foundation, Interdisciplinary Center on Aging at the University of Missouri, University of Missouri Research Council, and Iowa Gerontological Nursing Intervention Research Center

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation
Allocation concealment (selection bias)	Low risk	Allocation was conducted by a person independent of the research team to either the continuous self-improvement intervention group or the attention control group. Person allocating was blinded
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Principle Investigator conducted the home visits with the intervention group
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective: electronic monitoring records
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Subjective: adherence diaries and perception of burden - not clear who was asking patients this but could have been influenced feasibility - could of been influenced
Incomplete outcome data (attrition bias) All outcomes	High risk	28% (2/7) had unusable data from Medication Event Monitoring System data
Selective reporting (reporting bias)	High risk	Number of outcomes outlined in the protocol were not reported
Other bias	Unclear risk	Small sample but only a feasibility study; received financial incentive

Schmid 2016

Methods	• Study design: parallel RCT; 56 assessed for eligibility, 46 randomised • Study duration: 12 months • Study follow-up: 12 months
Participants	• Country: Germany • Setting: community • Adult kidney transplant recipients • Number: intervention group (23); control group (23) • Median, range (years): intervention group (46, 18 to 59); control group (51, 19 to 66) • Sex (M): intervention group (61%); control group (48%) • Exclusion criteria: not reported

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: Telehealth
	
	Intervention group
	
	• Standard care + telemedically supported care
	  * Chronic case management for 1st year post transplant, case management process applicable for acute care situations and a telemedically equipped team
	  * Prior to discharge nurse-trained participants in operation of interactive terminal which enabled remote telemonitoring and prompt real-time video consultations.
	  * Participants answered standardised multiple-choice questionnaires via the terminal daily
	  * Data transferred through safe web-based connection
	  * Supplementary briefings were provided by calls, voice mailbox, SMS and emails to the nurses mobile telephone ensuring prompt responses
	  * Nurse had 24-hour access to all significant medical data. After discharge nurse provided planning, linking and monitoring for achievement of jointly agreed goals, underpinned by self-management and self-care related actions
	  * Participants had continuous access to expert to discuss specific challenges and to set daily priorities.
	  * Nurse regularly assessed details via telemonitoring, VC and mobile phone. If acute issues emerged nurse contacted nephrologist for intervention
	  * Nurse regularly assessed details via telemonitoring, VC and mobile phone. If acute issues emerged nurse contacted nephrologist for intervention
	
	Control group
	
	• Standard care
	  * Received a booklet for recording drug regimen, vital signs and fluid balance
	  * Educational booklet
	  * Transplant nurse provided counselling which included standardised self-management information about disease prevention, immunosuppression adherence and self-monitoring
	  * Regular check-ups with nephrologist combined with best clinical practice check-up program. Physicians determined time intervals between check-ups according to risk stratification and further consultations when needed

Outcomes	Data reported at baseline, 3, 6 and 12 months. Used intention-to-treat analysis • Medical outcomes - unplanned hospital admissions, length of unplanned admissions, acute rejection rate, length of time before rejection therapy initiated, ambulatory care visit rate • Medication adherence - composite adherence score and CAS % grade (Basel Assessment Adherence to Immunosuppression scale (BAASIS), collateral reports from physicians and nurses, hit target tac level) • Quality of life (fragebogen alltagskeben ALL, ESRD-SCL, BSI-18) • Cost analysis (unplanned inpatient costs, work time %)

Schmid 2016 *(Continued)*

Notes	• Funding source: The project received funding by the European Union within the framework of the INTERREG IV Oberrhein (grant reference number “A12—Promethee")

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer generated randomisation schedule provided by the Institute of Medical Biometry and Medical Informatics
Allocation concealment (selection bias)	Unclear risk	Quote: "concealed allocation" but no further information
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Nurses delivering intervention could not have been blinded
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Hospital admissions, LOS, adherence
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Psychosocial measures were validated and assessed by psychologist - no mention of whether psychologist blinded to allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Used intention-to-treat analyses, low loss to follow-up
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Small sample size

Schulz 2007

Methods	• Study design: parallel RCT • Study duration: 3 months • Study follow-up: 3 months
Participants	• Country: Germany • Setting: community, dialysis unit • Relevant health status: receiving maintenance HD and experienced average weight gain of at least 1.5 kg between 2nd and 3rd dialysis of the week • Number (randomised/analysed): intervention group (60/43); control group (60/58) • Mean age ± SD (years): intervention group (65.7 ± 14.7); control group (66.5 ± 13.8) • Sex (M/F): intervention group (30/30); control group (31/29) • Exclusion criteria: not reported

Schulz 2007 *(Continued)*

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: Bluetooth, electronic monitors
	
	Intervention group
	
	• Telemetric body weight monitoring
	  * Weight taken pre- and post-dialysis + telemetric weight monitoring
	  * Patients instructed to weight their body weight under possibly equal terms daily before and after dialysis and once daily on days without dialysis at a time corresponding to start of dialysis
	  * TBWM enabled with Bluetooth interface for automatic data transmission after each weight. If > 0.75 kg alarm report sent to physician by email.
	  * Weight gain discussed at next appointment or by telephone (If weight gain > 1.5 kg mandatory phone intervention conducted)
	  * Alarm generated once per day at most
	  * Under usage report sent to physician if no weights for 3 days
	  * Monthly and weekly reports generated of weight parameters and were given to patients during dialysis
	
	Control group
	
	• Weight taken pre- and post-dialysis

Outcomes	Primary outcomes (assessed baseline and 3 months) • IDWG: average weights and weight changes • UF Secondary outcomes • Mean time duration on dialysis (baseline, 3 months) • SBP and DBP (baseline, 3 months) • haemoglobin variability (over 3-month intervention period) • Hospitalisations (over 3-month intervention period) • Vascular events (over 3-month intervention period) • Death (over 3-month intervention period)
Notes	• Death, vascular events and haemoglobin variability data were not reported in any abstracts or papers • Funding source: supported by Roche Pharma Deutschland GmbH

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias)	High risk	Physicians received alarms from study participants

Schulz 2007 *(Continued)*

Blinding of personnel		
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	All outcomes are objective
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Insufficient information to permit judgement
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	High risk	Stated outcomes in abstracts and papers have not been reported
Other bias	Unclear risk	Insufficient information to permit judgement

SUBLIME 2016

Methods	• Study design: parallel RCT • Study duration: 3 month intervention, 6 month maintenance phase • Study follow-up: 9 months
Participants	• Country: Netherlands • Setting: outpatients • Patients with eGFR > 25mL/min with CKD or kidney transplant recipient; diagnosed with hypertension, sodium intake > 130mmol/day • Number: 99, numbers per group not reported • Mean age ± SD: 57 ± 12 years • Sex: not reported • Exclusion criteria: not reported

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: website, internet
	Intervention group
	• Web-based self-management system
	  * Dedicated to dietary sodium restriction with individual e-coaching
	  * Two group meetings in 3-month intervention phase, followed by 6-month maintenance phase
	Control group
	• Not described

Outcomes	Outcomes measured at baseline, 3, 6, 9 months • BP • electrolytes • dietary sodium intake (measured using 24 urine collection) • QoL and well being • Healthcare expenditure from questionnaires • Incremental cost-effectiveness ratio

SUBLIME 2016 *(Continued)*

Notes	• Abstract-only publication • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective data such as BP, 24-hour urine sodium, cost-analysis
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No reporting of how well being and quality of life is measured
Incomplete outcome data (attrition bias) All outcomes	High risk	28% drop out in intervention, 3.3% drop out in control - no mention if these participants differed; no mention of whether used ITT analyses
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Swallow 2016

Methods	• Study design: 3-phased RCT • Study duration: 20 weeks • Study follow-up: 20 weeks
Participants	• Country: UK • Setting: community • Parents or carers of children with CKD stages 3-5 • Number (children/parents recruited; children/parents analysed): intervention group (18/29; 14/19); control group (21/29; 16/22) • Mean age ± SD (years): Parents ages: 5% aged 16-24 years; 60% aged 25-49 years; 35% aged 50-64 years • Sex (M parents): intervention group (40%); control group (not reported) • Exclusion criteria: not reported

Swallow 2016 *(Continued)*

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: internet, website
	
	Intervention group
	
	• Interactive health communication application
	  * Online parent information and support application
	  * Website included: glossary of terms, frequently asked questions, case studies/personal accounts of families living with CKD, including those who have experienced transplants, Renal recipes for healthy eating, links to other CKD-specific websites with animations, family-to-family area to communicate with others, living with CKD videos of clinical procedures
	
	Control group
	
	• Usual care, support from professionals

Outcomes	Outcome measures (assessed pre-test and 20 weeks) • Usage - using Google Analytics, number and timing of site visits and page views, time spent on the site per visit and user device type • Acceptability of OPIS was assessed using a modified version of the Suitability Assessment of Materials • Usability was assessed by a modified version of the User Interface Satisfaction questionnaire • Qualitative interviews to explore readability of materials; accessibility, perceived accuracy, tone, organization and visual interest of materials; the value and use of learning materials including any multimedia content; the value and role of the family-to-family area; perceptions of personal confidence and competence in home-based care-giving during the trial; technical issues and methods the parent used to access OPIS
Notes	• Funding source: National Institute for Health Research (NIHR) under the Research for Patient benefit programme (PB-PG-0110-21305)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomized block sizes in an allocation ratio of 1:1 stratified by CKD stages (3 versus 4/5) and ethnicity (White/Black versus South Asian)
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Not possible due to the nature of the intervention
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Insufficient information to permit judgement but likely blinding would have been broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Google analytics for usage
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Qualitative interviews and validated questionnaires, unclear who conducted interviews.

Swallow 2016 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	High risk	22% to 24% loss to follow-up, reasons given; no mention of whether these participants were different
Selective reporting (reporting bias)	High risk	Insufficient information to permit judgement
Other bias	Unclear risk	Only technologically savvy families could have participated. Lower recruitment rate from south Asian descent participants

TAKE-IT 2014

Methods	• Study design: prospective, parallel, unblinded RCT • Study duration: February 2012 to May 2016 • Study follow-up: 12 months, with 3 month non-intervention run-in period
Participants	• Country: USA and Canada • Setting: multicentre (8 sites) • Adolescents at least 3 months post kidney transplant aged 11 to 24 years • Number: intervention group (81); control group (88) • Median age (IQR) (years): intervention group (15.5 (13.2-17.4)); control (15.8 (13.3-17.5) • Sex: 59% male; intervention group (61%); control group (57%) • Exclusion criteria: impending graft failure; severe neurocognitive disabilities lack of electronic pill-box connectivity; use of liquid immuno-suppressive medications; having a sibling participating in the study; participating in another adherence-promoting intervention study; inability to communicate comfortably in English or French

Interventions	• Intervention type classification: behavioural counselling
	• eHealth intervention used: blue-tooth, electronic monitors
	
	Intervention group
	
	• Usual clinical care plus electronic pill box with alerts
	  * Adherence Support Team (AST) comprised of the participant, 1-2 parents, trained site Coach.
	  * The coach delivered standardized education on immunosuppressive medications by slide presentation, identified adherence barriers using the AMBS/PMBS27 and the last 3 months of electronic monitoring data, and then used “Action-Focused Problem Solving” to address barriers selected as most important by the patient. The patient chose 1 or 2 barriers to address at each session.
	  * At subsequent sessions, the coach, patient, and parent jointly reviewed the electronic adherence monitoring data from the prior 3 months to identify adherence patterns and guide the development and revision of action plans. Patients could continue to work on the same barrier(s) or select a new barrier to address.
	  * Participant chose to receive text message, email or visual cue dose reminders throughout the study
	
	Control group
	
	• Usual clinical care
	  * Control group study visits were conducted at the same intervals as intervention visits
	  * consisted of the coach engaging in active listening and providing nonspecific support only
	  * Adherence was not discussed with participants.
	  * Electronic pill box to track adherence, however no alerts or feedback given to participants

Outcomes	Primary outcome (12 months)

TAKE-IT 2014 *(Continued)*

- Medication "taking adherence" defined as proportion of prescribed doses taken. Measured through electronic monitoring, pharmacy dispensing records, self reporting and variability in tacrolimus and sirolimus trough levels. Each day was scored as 0%, 50%, or 100%, depending on whether the patient took none, half, or all prescribed doses.
- "Timing adherence" defined as proportion of prescribed doses taken within 1 hour before to 2 hours after the prescribed dosing time. Timing adherence scores were given the values 0%, 50%, or 100%.

Secondary outcomes (12 months)

- Adherence: standard deviation of tacrolimus trough concentrations and self-reported (MAM-MM).
- Graft outcomes: graft failures or deaths, acute rejections, percentage change in glomerular filtration rate
- adverse events: death, opportunistic viral infections, hospitalisations, other medical conditions requiring treatment

Notes
- Funding source: The study was funded by the American NIH, National Institutes of Diabetes, Digestive and Kidney Diseases (R01DK092977)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation
Allocation concealment (selection bias)	Low risk	Allocation is maintained until 3 month visit
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Not blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Not blinded
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	primary and secondary outcomes predominantly measured objectively
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Subjective assessment of adherence used in addition to objective methods
Incomplete outcome data (attrition bias) All outcomes	Low risk	12% loss after randomisation in intervention group, groups were balanced with respect to age, time since transplant, gender. Analyses conducted using intention-to-treat and as-treated
Selective reporting (reporting bias)	Low risk	All stated outcomes were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Welch 2013

Methods	• Study design: parallel RCT; 89 assessed for eligibility, 44 randomised • Study duration: 6-week intervention • Study follow-up: 8 week follow-up
Participants	• Country: USA • Setting: community, dialysis unit • Patients receiving maintenance HD • Number (randomised/analysed): intervention group (24/16); control group (20/17) • Mean age ± SD (years): intervention group (53 ± 15.1); control group (47.1 ± 11.5) • Sex (M/F): intervention group (12/12); control group (13/7) • Exclusion criteria: living in an assisted or extended care facility, receiving outpatient HD on a temporary basis following a PD complication or an episode of transplant rejection, reported having no intent to comply with dietary or fluid restrictions and were receiving home HD.

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: PDA application
	
	Intervention group
	
	• Dietary Intake Monitoring Application (DIMA)
	  * Electronic dietary self-monitoring app
	  * Participants trained for 2-3 hours; used for 1 week to familiarise
	  * Participants can scan food labels, feedback screen in relation to dietary prescriptions to facilitate awareness of performance attainment, totals automatically computed
	  * Dietary and usage data downloaded at each dialysis session
	  * 24-hour telephone number provided
	
	Control group
	
	• Daily Activity Monitoring Application (DAMA)
	  * DAMA to ensure these participants got equal time as to DIMA
	  * Participants used DAMA for 1 week to familiarise; trained for 30 min
	  * Instructed to self-monitor activity in 8 categories (walking, biking, weight lifting, shopping, yard work, childcare, housework, cooking)
	  * Selected icons representing activities and amount of time. Could view total daily activity time.
	  * Usage data downloaded every dialysis session
	  * 24 hour telephone number provided

Outcomes	• Average IDWG (baseline and 6 weeks) • Cardiac Diet Self-Efficacy Instrument and Fluid Self-Efficacy Scale (baseline, 6 weeks, 14 weeks) - RAs read out questionnaires to patients • Benefits of Sodium Adherence and Fluid Adherence Scale (baseline, 6 weeks, 14 weeks) - RAs read out questionnaires to patients • 7-item mastery scale (baseline, 6 weeks, 14 weeks) - RAs read out questionnaires to patients • Dietary intake in intervention only (Week 1, week 6) - Automatically computed dietary intake data based on patient recorded food items from DIMA. Summed weekly intake and then divided by number of days for which entries made • Acceptability (end of study)
Notes	• Dietary intake data was only recorded and reported for the intervention group • Funding source: supported by grants from NIH/National Institute of Biomedical Imaging and Bioengineering (R21EB007083), a T32 Postdoctoral Training Grant (NIH T32 NR007066), and Indiana University School of Nursing Research Investment Funds

Risk of bias

Welch 2013 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was blocked and stratified by dialysis unit
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Blinding not possible
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	No mention of blinding but likely would be broken
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures (IDWG) used
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Participant data were collected by RAs during HD treatment. The RAs read questionnaire items for baseline and follow-up data collections to each participant, who responded verbally to each item
Incomplete outcome data (attrition bias) All outcomes	High risk	overall attrition rate of 25% by the end of the 8-week follow-up. There were no statistically significant differences in age, gender, race, dialysis unit, or group between those who continued in the study and those who did not
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	High risk	Under powered, small sample size only 2 dialysis units involved and not generalisable

White 2010

Methods	• Study design: pilot RCT; 40 randomised • Study duration: 6 month • Study follow-up: 6 months
Participants	• Country: Canada • Setting: community, dialysis unit • Patients receiving maintenance PD patients with diabetes • Number: intervention group (20); control group (20) • Mean age ± SD (years): not reported • Sex: not reported • Exclusion criteria: not reported
Interventions	• Intervention type classification: behavioural counselling • eHealth intervention used: Telehealth Intervention group

White 2010 *(Continued)*

	• Telemonitoring
	  * Daily interaction with telemonitoring station, with health coaching and nursing staff responding to patient responses
	  * Two-way video conferencing utilised
	
	Control group
	
	• Usual care: no description

Outcomes	• Hospitalisations • ED visits • QoL • Satisfaction • Ease of use • Self-management
Notes	• 2 abstracts and 1 poster • Author contacted who gave details on randomisation • Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Author replied to email stating neither participants or personnel were blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	High risk	Author replied to email stating neither participants or personnel were blinded
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Objective measures (ED visits, hospitalisations) used
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Subjective measures using self-report at high risk of bias
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Williams 2017

Methods	• Study design: RCT, 31 enrolled and randomised, 29 reported • Study duration: 5 weeks • Duration of follow-up: 5 weeks
Participants	• Country: USA • Setting: community, HD unit • Adults aged 18 to 75 years receiving maintenance HD for more than 3 months; required to have the ability to walk without assistance or assistive devices to ensure device was able to track activity • Number: intervention group (15); control group (14) • Mean age ± SD (years): intervention group (56 ± 13); control group (48 ± 15) • Sex (M): intervention group (60%); control group (21.4%) • Exclusion criteria: unstable health (e.g. acute infections, congestive heart failure NYHA class 4 and/or unstable angina); hospitalised within 3 months before enrolment for non-access-related reasons; cognitively impaired; nickel allergy; patients who had previously worn activity tracking devices

Interventions	• Intervention type classification: self-monitoring
	• eHealth intervention used: blue-tooth, electronic monitor
	
	Intervention group
	
	• Fitbit Flex tracker with feedback
	  * As per control group
	  * Received a report of activity and sleep data in the week leading to the date of each HD treatment
	
	Control group
	
	• Fitbit Flex tracker
	  * Activity and sleep data collected over the course of 5 weeks
	  * Instructed to wear bracelet at all times, even when in water and worn on the non-vascular access arm.
	  * Fitbit Flex tracks activity parameters (steps taken, distance travelled) and sleep duration and quality (minutes asleep, total time in bed)
	  * Data downloaded from the device to the user account during each HD treatment
	  * Asked to keep a daily sleep log (recorded times they went to bed and the times they woke up)

Outcomes	• Human activity profile (sleep and physical activity) • Physical Activity Questionnaire (regarding participant experience) • Laboratory test (obtained from electronic health records) - usual monthly blood tests plus CRP, albumin, pre-albumin, haemoglobin • Clinical parameters: IDWG, blood pressures (pre and post dialysis)
Notes	• Funding source: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Study described as randomised, method of random sequence generation not reported
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement

Williams 2017 *(Continued)*

Blinding of participants and personnel (performance bias) Blinding of participants	High risk	Participants could not have been blinded
Blinding of participants and personnel (performance bias) Blinding of personnel	Unclear risk	Unclear who provided the feedback to participants
Blinding of outcome assessment (detection bias) Objective outcome	Low risk	Sleep and physical activity measured objectively
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No subjective measures, other than patient experience.
Incomplete outcome data (attrition bias) All outcomes	Low risk	2 participants were not included in analyses as they died during the study period, no mention of which group they were allocated to, however low rate of missing data overall (n = 2; 6%).
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

ACEi - angiotensin-converting enzyme inhibitor; ACR - albumin:creatinine ratio; ARB - angiotensin receptor blocker; BP - blood pressure; BUN - blood urea nitrogen; CBT - cognitive behaviour therapy; CKD - chronic kidney disease; CrCl - creatinine clearance; CSA - cyclosporin; DBP - diastolic blood pressure; ED - emergency department; eGFR - estimated glomerular filtration rate; EMD - electronic medication dispenser; ESKD - end-stage kidney disease; HbA1c - haemoglobin A1c (glycated); HD - haemodialysis; HEiQ - Health Education Impact Questionnaire; HRQoL - health-related quality of life; IDWG - interdialytic weight gain; LDL - low density lipoprotein; MAP - mean arterial pressure; MDRD - Modified Diet in Renal Disease; MEMSI -Medication Self-Management Intervention; PD - peritoneal dialysis; PDA - personal digital assistant; PHR - personal health record; PTH - parathyroid hormone; QoL - quality of life; RCT - randomised controlled trial; SBP - systolic blood pressure; SBP - systolic blood pressure; SCr - serum creatinine; SMS - short messaging service; TAC - tacrolimus; UACR - urine albumin:creatinine ratio; UF - ultrafiltration; VAS - visual analogue scale

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Abdel-Kader 2011	Wrong target population
Chen 2011e	Wrong intervention
Korus 2017	Wrong target population
Morales-Barria 2016	Wrong study design
RaDIANT 2014	Wrong target population
Roberto 2009	Wrong target population
SMILE 2010	Wrong intervention
Warren 2009	Wrong study design

Study	Reason for exclusion
Wilson 2014	Wrong target population

Characteristics of ongoing studies *[ordered by study ID]*

CONNECT 2017

Trial name or title	Assessment of telehome monitoring in patients on peritoneal dialysis: a multicentre randomized controlled trial (CONNECT)
Methods	Parallel assignment, RCT
Participants	Adult patients on PD for at least 3 months, the patient or their primary care giver able to read and speak English, the patient or primary care giver cognitively and physically capable and willing to interact with a tablet computer and perform self-measurements (e.g. taking weight)
Interventions	Interventions • Patients in this arm will use the telehome monitoring device (a mobile tablet) to support them with their peritoneal dialysis (communication, treatment tracking, supply tracking, appointment reminders, educational content) Standard of care • Patients in this arm use the standard of care for peritoneal dialysis, which is simple telephone communication and using pen and paper log to track their treatments and supplies
Outcomes	Primary outcome: composite of technique failure (switching to HD for ≥ 12 weeks), infections (peritonitis, exit-site, tunnel) and hospital encounters (ER visits, hospitalisations) Secondary outcome: HRQoL (Kidney Disease Quality of Life-36 (KDQOL-36) Instrument and EQ-5D to assess HRQoL), time spent communicating (measured through automated telephone logs and paper telephone logs that are documented by nurses), number of missed appointments, nurse overtime hours, number of clinic visits, hospitalisation days, nursing costs, healthcare utilisation costs, dialysis supply costs
Starting date	June 2016
Contact information	Melissa Subnath melissa.subnath@lhsc.on.ca
Notes	Clinical trials last updated on 11 December 2017, recruitment is ongoing

eNEPHRO 2017

Trial name or title	Medico-economic evaluation of a telemedicine system for the management of chronic renal failure
Methods	Open, label, parallel group, RCT
Participants	Adult patients with CKD stage 3b-4 (nephrology care < 2 years), ESKD on ambulatory dialysis, kidney transplantation (> 3 months and < 12 months), patients can use IT tool or having someone in entourage who knows how to use
Interventions	Usual Care

eNEPHRO 2017 *(Continued)*

	eNephro Application Telemedicine system which is a collaborative and expert system, consisting of: A dynamic shared medical record for the collection of administrative, medical, biological and clinical data for each patient. All health professionals can access the folder and fill in the support. It is the same for patients treated at home. A secure messaging for communication between health professionals and between patients and health professionals Expert systems analyzing data from each patient A management tool of therapeutic education A compliance assistance: electronic pillbox and pharmaceutical care Patients included in this study are major patients, male and female who signed a consent form. These patients have a chronic renal failure moderate to end up being treated by ambulatory dialysis or kidney transplantation. The patients of each population will be randomly assigned in group 1 (traditional care) or in group 2 (traditional care added by telemedicine system)
Outcomes	Primary outcomes: combined endpoint achievement of target BP and proteinuria (measured at 1 year), cumulative duration of hospitalisations for 1 year, cumulative duration unplanned short stay for 1 year, survival at one year Secondary outcomes: compliance (baseline, 6 months, 12 months), QoL (baseline, 12 months), anxiety-depression state (baseline, 12 months), change in eGFR (baseline, 12 months), anaemia control (12 months), consultations and hospitalisations unplanned (12 months), disease costs (12 months), intervention costs (12 months), acceptability (12 months)
Starting date	November 2015
Contact information	Professor Michele Kessler m.kessler@chu-nancy.fr
Notes	Clinical trials last updated April 2016, recruitment for the study is ongoing, estimated completion Dec 2016

Jung 2017

Trial name or title	The efficacy and stability of an information and communication technology-based centralized monitoring system of adherence to immunosuppressive medication in kidney transplant recipients: study protocol for a randomized controlled trial
Methods	Multicentre, open-label, prospective, RCT (1:1 randomisation). The planned follow-up duration is 6 months.
Participants	Kidney transplant recipients, n = 114
Interventions	Intervention • ICT-based centralized clinical trial monitoring group (n = 57). Participants are given a smart pill box equipped with a personal identification system. The adherence-related information obtained from the pill box is saved, monitored, and sent out via a home monitoring system. Of the home monitoring system data, those necessary for the clinical trial are extracted and incorporated into the electronic Case Report Form (eCRF) system. All data is consolidated and managed within the comprehensive clinical trial management system (CTMS). In the ICT- based, centralized clinical trial monitoring group, feed- back is sent to both patients and medical staff in the form of texts and pill box alarms if there is a dosage/ dosing time error or a missed dose. To keep a drug administration diary that specifies date, whether a dose is taken or not, dosing time, and dosage Control • Ambulatory follow-up group (n = 57). To keep a drug administration diary that specifies date, whether a dose is taken or not, dosing time, and dosage
Outcomes	The primary outcome in this trial is adherence to medication, including dose-taking compliance, dose-frequency compliance, dose-interval compliance, drug holidays, medication possession ratio

Jung 2017 *(Continued)*

	Secondary outcomes: Both groups are to make six office visits after randomisation at 4, 8, 12, 16, 20, and 24 weeks. Each visit requires measurement of blood drug level, creatinine level, and estimated glomerular filtration rate (eGFR). Serum BK virus is assessed at 12 weeks and Panel reactive anti- body (PRA) at 24 weeks. At each visit, subjects go over the diary with investigators and fill out a questionnaire using the Modified Morisky Adherence Scale. The ICT-based centralized clinical trial monitoring group completes a patient Satisfaction Questionnaire developed by the ICT Clinical Trial Support Center at 4 and 24 weeks. Cost-effectiveness evaluation parameters include installation of the ICT-based centralized monitoring system, additional hospitalisation due to non-adherence, ambulatory tests, and trips for hospital visits. Process evaluation: The Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework will be used in order to evaluate translatability and feasibility of ICT- based centralized monitoring system
Starting date	January 2017
Contact information	ylkim@knu.ac.kr Department of Internal Medicine, Kyungpook National University School of Medicine, Daegu, South Korea
Notes	Clinical trials registration: NCT03136588, registered on 20 April 2017

KARE 2015

Trial name or title	The Kidney Awareness Registry and Education (KARE) study: protocol of a randomized controlled trial to enhance provider and patient engagement with chronic kidney disease
Methods	Single blind, factorial assignment, RCT
Participants	CKD (eGFR < 60mL/min), speak Chinese, Spanish or Cantonese, have primary care provider
Interventions	Experimental: ATSM + Health Coach and CKD Registry - primary care providers can access online CKD registry to identify patients, get notifications of CKD status and access guidelines and education materials + patients receive automated telephone self-management which blends automated phone calls with live targeted call-backs from a health coach. Patients will receive bi-weekly automated calls for 52 weeks in their native language, consisting of pre-recorded queries pertaining to CKD management, preventive services, and lifestyle changes. Patients will interact with the system using a touch-tone keypad; Out-of-range values or invalid responses will prompt a live call-back within 24-48 hours by a health coach Active comparator: CKD registry only Active comparator: Automated telephone self-management + health coaching Placebo comparator: usual care - primary care providers will manage their patients with CKD as per usual
Outcomes	Primary outcome: change in BP (baseline, 12 months) Secondary outcomes: change in CKD awareness, functional status and symptoms (baseline, 12 months)
Starting date	April 2013
Contact information	Dr Delphine Tuot delphine.tuot@ucsf.edu

KARE 2015 *(Continued)*

	Alexandra Velasquez velasqueza@medsfgh.ucsf.edu
Notes	Clinical trials last verified October 2016, recruitment is ongoing, estimated completion December 2017

Kosaka 2017

Trial name or title	Assessment of efficacy of a CKD support decision making application and home blood pressure measurement system in patients with CKD: study protocol of a randomized, controlled trial
Methods	Clinical, prospective, RCT with balanced randomisation (1:1)
Participants	Inclusion criteria: patient at the kidney internal medicine outpatient clinics, age over 20 years old, provision of informed consent, to be assure by doctor, RRT not yet selected, and eGFR < 60
Interventions	Intervention: will receive conventional care from the attending physician; the patient and physician will also be given a tablet equipped with the CKD-SDM app and an automated sphygmomanometer for home blood pressure monitoring for 2 months. The CKD-SDM app includes 61 items in three categories: "Let's study CKD", "What's about RRT?", and "Learn and consent of CKD". Control: will receive conventional care and only the automated sphygmomanometer for 2 months
Outcomes	The primary outcome measure is change in home BP data from baseline. Secondary outcomes are renal function, spot urine test, self-efficacy for chronic illness, disease burden, knowledge level of self-management in CKD, and decision for RRT
Starting date	Recruitment began in March 2017
Contact information	Shiho Kosaka skosaka-tky@umin.ac.jp
Notes	UMIN clinical trials last updated on 25/07/2017

MAGIC 2016

Trial name or title	MAGIC Study: aims, design and methods using SystemCHANGE to improve immunosuppressive medication adherence in adult kidney transplant recipients
Methods	4 year, two-centre, RCT (single blind)
Participants	Adult kidney transplant recipients, prescribed at least 1 immunosuppressive medication taken twice daily, functioning kidney transplant, received kidney-only transplant, transplant physician has agreed can participate, able to speak, hear and understand English, able to open electronic medication cap, self-administering immunosuppressive medication, has telephone / access to telephone, no cognitive impairment, no other life-shortening diagnoses, not currently hospitalised
Interventions	Intervention: SystemCHANGE - initial home visit conducted, 2 weeks later phone review and then monthly phone calls over 6 month intervention. Phone reviews include reviewing electronic medication reports, goal setting, determining process owners, identifying lifestyle routines, identifying cyclical nature of routines, possible solutions for change and story boards for success. Research assistant encouraged patient to continue using electronic monitoring cap for an additional 6 months during maintenance phase.

MAGIC 2016 *(Continued)*

	Attention control: home visit and monthly phone reviews. these patients receive educational materials that address healthy living after transplantation. if participant asks questions about medication they are directed back to their transplant team. encouraged to continue using electronic medication monitoring and diary for additional 6 months of maintenance phase
Outcomes	Primary outcome: medication adherence - MEMS Cap, cost-effectiveness (ICER) Secondary outcomes: Blood creatinine, BUN level, acute and chronic rejection, infection, health-related QoL, death will be collected retrospectively from medical records
Starting date	June 2014
Contact information	Dr Cynthia Russell RussellC@umkc.edu
Notes	clinical trials last updated October 2016, recruitment in study is ongoing, estimated completion date May 2018

NCT00394576

Trial name or title	Assessing novel methods of improving patient education of nutrition: ehealth, health literacy and chronic kidney disease
Methods	RCT
Participants	CKD stage 3, 4, 5, aged 18 to 90 years, ability to read English, adequate visual acuity
Interventions	Intervention: web-based nutritional education intervention + usual care Usual care
Outcomes	Primary outcome: phosphorus knowledge, dietary phosphorus intake (as per serum phosphate, calcium, PTH, calcium phosphorus product), dietary phosphorus intake as per 24 hour recall diary Secondary outcomes: correlations between dietary phosphorus intake, serum phosphorus levels and CECs will be made
Starting date	November 2006
Contact information	Dr Jonathan B Jaffery
Notes	Clinicaltrials.gov not updated in 2 years, previous estimated completion date June 2009) No published data has been found

NCT02097550

Trial name or title	Primary care eHealth intervention for improved outcomes in chronic kidney disease (CKD eHealth)
Methods	Open label, parallel assignment, RCT
Participants	Adult CKD stage 3a (eGFR 45-59) with poorly controlled risk factors for CKD progression and/or CVD morbidity / death and stage 3B (eGFR 30-44) who have primary care provider, non-pregnant, ability to use computer or smartphone, ability to understand English

NCT02097550 *(Continued)*

Interventions	Experimental: eHealth Intervention - Patients randomized to this arm will receive eHealth materials every 2-4 weeks over the 12-month intervention. However, the exact nature of timing, dose, and delivery channel will be informed by the formative research. Developing and testing an electronic health intervention (that will combine secure e-mail, smartphone text message, and online video materials) to promote patient use of effective medications. Standard Care with physician
Outcomes	Primary: CKD metabolic control (12 months) - consist of clinical and laboratory measurements that are routinely performed in primary care settings Secondary: new indicated medication prescriptions (12 months), adherence proxy measures (12 months) - refills for prescriptions, patient and provider satisfaction (12 months), urine albumin (6 months), SBP (6 months), HbA1c (6 months), LDL-C (6 months), CKD progression measured by eGFR (12 months), DBP (12 months) HDL-C (12 months), total cholesterol (12 months)
Starting date	May 2016
Contact information	Dr Veronica Yank
Notes	Clinical trials last verified September 2016, trial is ongoing but not recruiting, estimated completion may 2018

NCT02610946

Trial name or title	Do technology apps improve compliance in adolescent renal transplant recipients?
Methods	Open label, efficacy study, RCT
Participants	Adolescent (12-18 years) kidney transplant recipients
Interventions	Intervention: Electronic application - Use of electronic apps (iphone or iPad mini) to determine whether it can improve compliance with transplant care and readiness to transition to adult care Paper-based calendars, reminders, medication list and BP, fluid intake tracking methods
Outcomes	Primary outcome: medication compliance (12 months) as assessed by presence or absence of antibody-mediated rejection based on donor-specific antibody levels Secondary outcome: readiness to transition (baseline, 12 months) - knowledge of transplant care and readiness to transition to adult care assessed by questionnaire of disease knowledge
Starting date	April 2015
Contact information	Dr Ha Tran hatran@stanford.edu Dr Priya Chandra priyac1@stanford.edu
Notes	Clinical trials last verified November 2015, recruitment ongoing

TELEGRAFT 2015

Trial name or title	A personalized follow-up of kidney transplant recipients using video conferencing based on a 1-year scoring system predictive of long term graft failure (TELEGRAFT study): protocol for a randomized controlled trial
Methods	Phase 4, open level, randomised, multicentric and prospective study Randomised to novel eHealth program versus standard care 1:1 randomisation, stratified by centres and performed at 1 year post kidney transplant with patient participation planned for 2 years
Participants	1 year post kidney transplant, access to high speed internet, without ongoing CMV or BKV infection, men and non-pregnant women, without mental disorders and provide informed consent
Interventions	eHealth intervention: provided with a USB which allows collection of medication information before video conferencing. USB opens a secure internet connection via an intuitive interface specifically designed for non-internet specialist patients. Also provided with tablet computer (e.g. iPad) devoted for video conferencing. Low risk patients will be interviewed 3 times with VC with pulse, weight, temperature and BP collected on USB, with only 1 in-person complete checkup conducted per year. For high risk patients they will have in person 1 complete check up and 5 standard visits + 6 additional VCs to reinforce follow-up. Standard care: patients classified as low risk of graft failure within first 8 years post-transplantation will be scheduled 4 visits at the hospital per year, whilst high risk patients will be scheduled 6 visits. Standard visits include clinical examination of BP, weight, blood and urine monitoring and 1 visit encompassing a complete checkup of further biochemistry, morphologic exams and questionnaires related to QoL and psychological dimensions.
Outcomes	Primary outcome is composite and defined by absence of major complications until 2 years post randomisation (e.g. patient alive with functioning kidney, without acute rejection episodes, without decrease in eGFR higher than 25% and without cancer. Secondary outcomes: to evaluate efficiency of system - incremental cost-effectiveness ratios, transplant specific QoL, evolution of psychological dimensions related to stress and coping, anxiety/depression
Starting date	February 2012
Contact information	aurelie.meurette@chu-nantes.fr
Notes	clinical trials updated May 2016 - recruitment ongoing, estimated completion date September 2020

Waterman 2015

Trial name or title	Explore Transplant at Home: a randomized control trial of an educational intervention to increase transplant knowledge for Black and White socioeconomically disadvantaged dialysis patients.
Methods	open label, parallel assignment, RCT
Participants	Dialysis patients who are aged 18-74 years, self-identify as African-American or White, household income at or below 250% of the federal poverty line, be able to read and speak English
Interventions	Standard Care - will not receive any educational materials and will only participate in surveys. dialysis providers will be asked to continue their current practices throughout study period without change.

Waterman 2015 *(Continued)*

	Experimental: Patient-Guided - Over an 8-month period, patients in the Patient-Guided intervention condition will receive four educational modules and twelve transplant education postcards in the mail. Modules will be mailed once every other month and consist of an introductory letter, a transplant video, and printed resources. Transplant education postcard will be mailed every two weeks following the mailing of each module, for a total of three postcards over the course of 6-weeks. Experimental: Educator-Guided - Patients in the Educator-Guided intervention condition will receive the same intervention components as those in the Patient-Guided condition; however, the key difference in this condition is that Educator-Guided patients will also receive telephonic support from an experienced clinical social worker in the role of a Transplant Educator to maximally facilitate learning. Telephonic meetings with the Transplant Educator will occur after the mailing of each study module, for a total of four calls, each lasting 20-minutes, totaling 1 hour and 20 minutes. Finally, Patient-Guided and Educator-Guided patients will have the option of enrolling in an educational text messaging service designed to supplement the ET education they are receiving in the mail.
Outcomes	Primary outcome: DDKT and LDKT knowledge (9 months) Secondary outcomes: informed decision making (9 months), decisional balance (9months)
Starting date	July 2014
Contact information	Dr Amy Waterman
Notes	Clinical trials last verified August 2016, study is ongoing but not recruiting patients, estimated completion august 2016

WISHED 2016

Trial name or title	The WISHED Trial: implementation of an interactive health communication application for patients with chronic kidney disease
Methods	Multi-centre RCT comparing the use of a secured web-based Interactive Health Communication Applications (IHCA) versus usual care in the promotion of home-based dialysis therapies
Participants	recruited through CKD clinics
Interventions	Usual care: continue to be seen in CKD clinic IHCA: usual care + participants will log into website during randomisation visit and provided an orientation of session to familiarise with website. email reminders to log-in are sent periodically and frequency of visits will be monitored. website provides easy navigation and provides content that encompasses informational and social support to reduce conflict and uncertainty in ESRD therapy decision-making. Website includes "Frequently asked questions", demonstration videos and still photographs of equipment and pre-recorded videos with local experts and existing patients. updated information will continue to be added by variety of content-expert healthcare professionals. social support component of website will include video and text narratives of patients addressing benefits and challenges of home dialysis and a moderated forum for patients to discuss issues surrounding home dialysis with current home dialysis patients. Participants will also be able to email "experts" including nephrologists, nurses and existing patients with questions
Outcomes	Outcomes measured at baseline, 6 months, 12 months Primary outcome: proportion of patients who receive any dialysis using home based therapy (PD or HHD) within 3 months of dialysis initiation. Those who have not initiated or have had pre-emptive transplant will be regarded as non-home-based dialysis outcomes.

WISHED 2016 *(Continued)*

	Secondary outcomes: proportion of patients intending to perform home-based therapy at 1 year, dialysis knowledge measured using locally developed tool, decision conflict, level of social support
Starting date	March 2012
Contact information	Dr Scott Brimble brimbles@mcmaster.ca Cathy Moreau cmoreau@stjoes.ca
Notes	Clinical trials updated April 2016, study recruitment is ongoing, estimated completion date June 2017

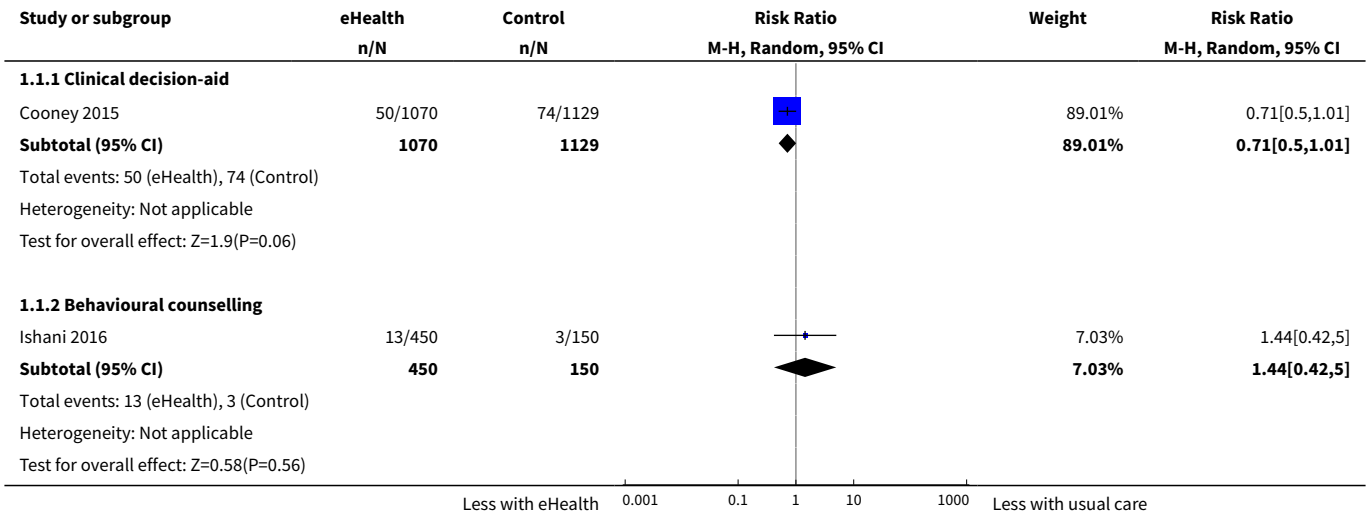
BP - blood pressure; BUN - blood urea nitrogen; CKD - chronic kidney disease; CMV - cytomegalovirus; CVD - cardiovascular disease; eGFR - estimated glomerular filtration rate; ER - emergency room; ESKD - end-stage kidney disease; HD - haemodialysis; HRQoL - health-related quality of life; PD - peritoneal dialysis; PTH - parathyroid hormone; QOL - quality of life; RCT - randomised controlled trial; RRT - renal replacement therapy

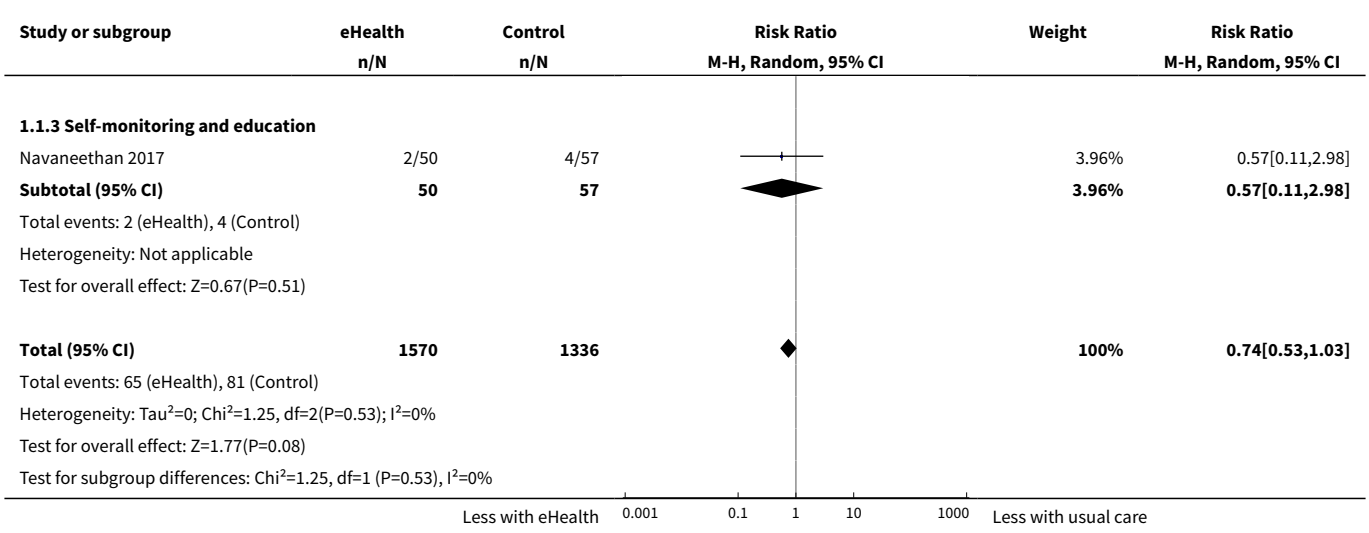
DATA AND ANALYSES

Comparison 1. Death

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	3	2906	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.53, 1.03]
1.1 Clinical decision-aid	1	2199	Risk Ratio (M-H, Random, 95% CI)	0.71 [0.50, 1.01]
1.2 Behavioural counselling	1	600	Risk Ratio (M-H, Random, 95% CI)	1.44 [0.42, 5.00]
1.3 Self-monitoring and education	1	107	Risk Ratio (M-H, Random, 95% CI)	0.57 [0.11, 2.98]

Analysis 1.1. Comparison 1 Death, Outcome 1 Death.

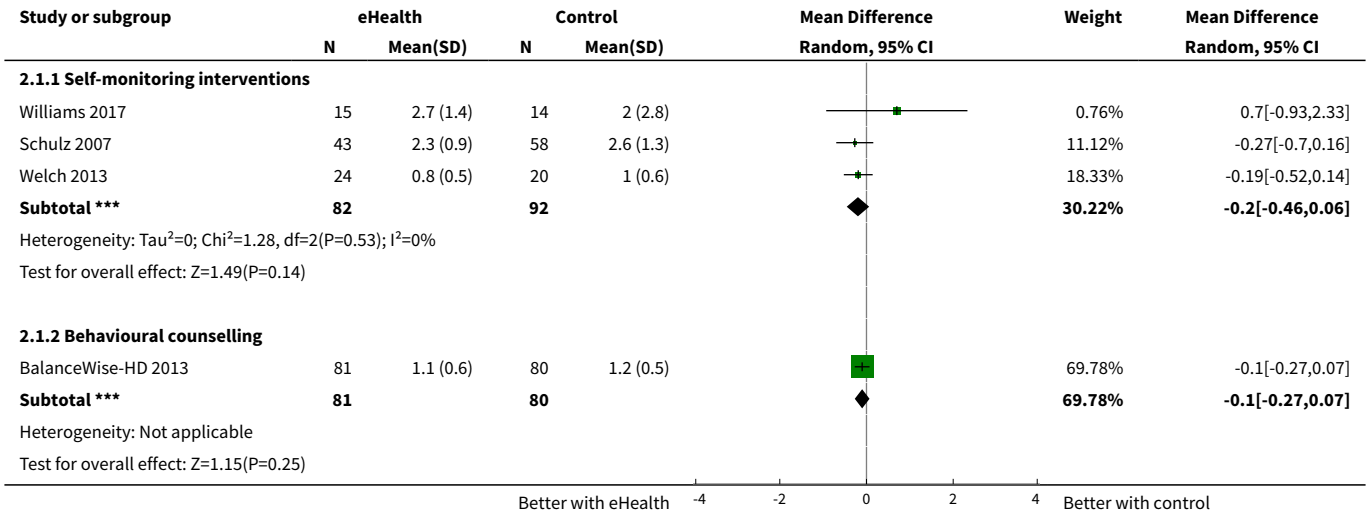


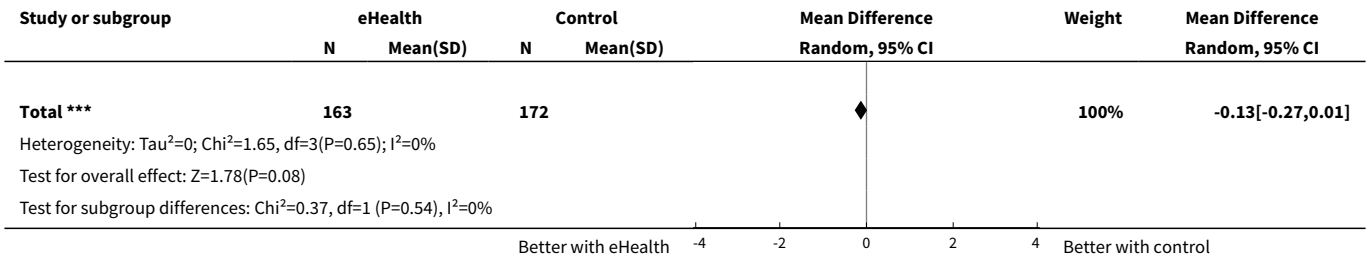


Comparison 2. Interdialytic weight gains

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Interdialytic weight gain	4	335	Mean Difference (IV, Random, 95% CI)	-0.13 [-0.27, 0.01]
1.1 Self-monitoring interventions	3	174	Mean Difference (IV, Random, 95% CI)	-0.20 [-0.46, 0.06]
1.2 Behavioural counselling	1	161	Mean Difference (IV, Random, 95% CI)	-0.10 [-0.27, 0.07]

Analysis 2.1. Comparison 2 Interdialytic weight gains, Outcome 1 Interdialytic weight gain.

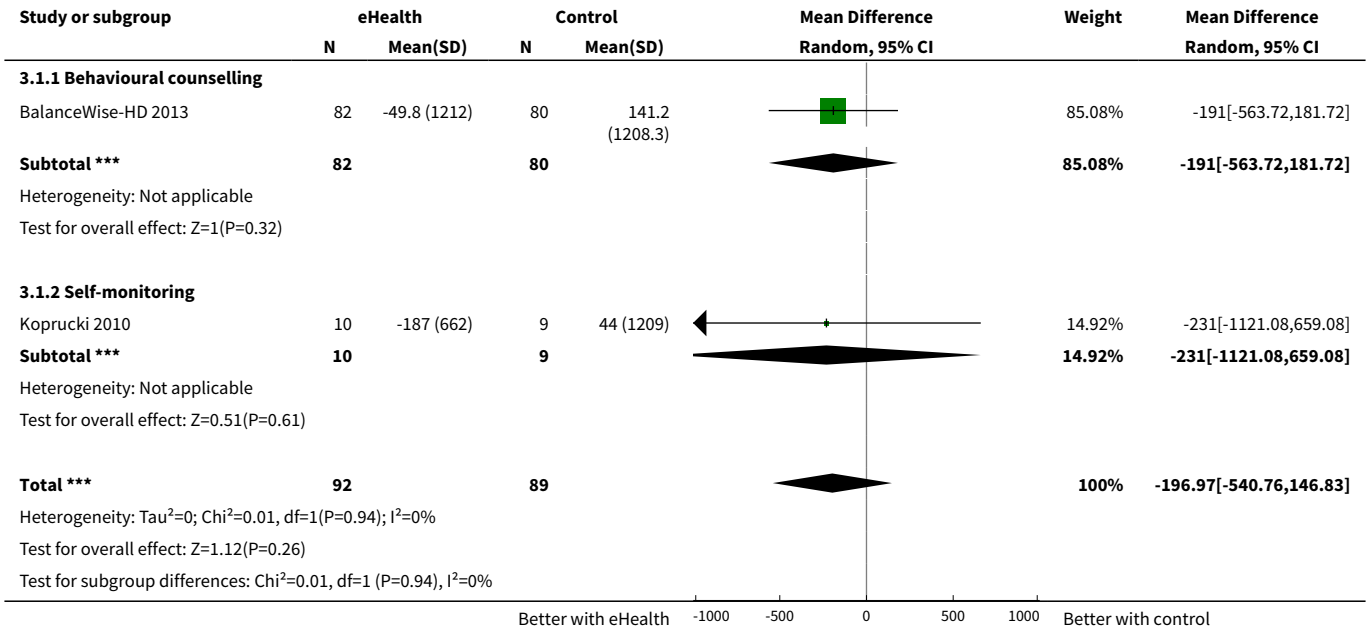




Comparison 3. Dietary sodium

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
1 Dietary sodium intake	2	181	Mean Difference (IV, Random, 95% CI)	-196.97 [-540.76, 146.83]
1.1 Behavioural counselling	1	162	Mean Difference (IV, Random, 95% CI)	-191.0 [-563.72, 181.72]
1.2 Self-monitoring	1	19	Mean Difference (IV, Random, 95% CI)	-231.0 [-1121.08, 659.08]

Analysis 3.1. Comparison 3 Dietary sodium, Outcome 1 Dietary sodium intake.



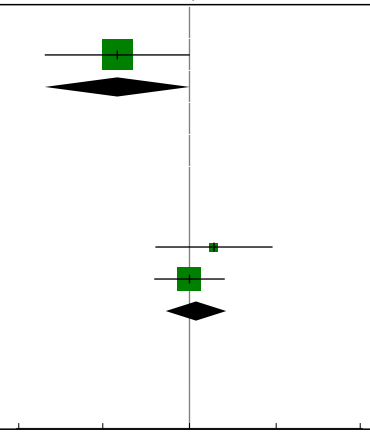
Comparison 4. Quality of Life (physical)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 General health perception	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Educational intervention	1	90	Std. Mean Difference (IV, Random, 95% CI)	-0.42 [-0.83, 0.00]
1.2 Behavioural counselling	2	507	Std. Mean Difference (IV, Random, 95% CI)	0.04 [-0.14, 0.21]
2 Physical functioning	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 Educational intervention	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Role-physical	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 Educational intervention	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4 Pain	4		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
4.1 Educational intervention	1	90	Std. Mean Difference (IV, Random, 95% CI)	0.07 [-0.34, 0.49]
4.2 Behavioural counselling	3	191	Std. Mean Difference (IV, Random, 95% CI)	0.18 [-0.42, 0.77]
5 Physical Component Score (PCS)	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
5.1 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 Clinical decision-aid	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6 Burden (KDQoL)	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
6.1 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6.2 Clinical decision-aid	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
7 Effects (KDQoL)	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
7.1 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 Clinical decision-aid	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

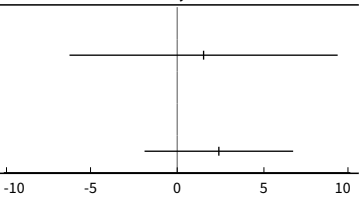
Analysis 4.1. Comparison 4 Quality of Life (physical), Outcome 1 General health perception.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
4.1.1 Educational intervention							
Baraz 2014	45	41 (16.9)	45	48.4 (18.2)		100%	-0.42[-0.83,0]
Subtotal ***	**45**		**45**			**100%**	**-0.42[-0.83,0]**
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%							
Test for overall effect: Z=1.95(P=0.05)							
4.1.2 Behavioural counselling							
Li 2014b	69	38.2 (17.5)	66	35.7 (17.7)		26.6%	0.14[-0.2,0.48]
BRIGHT 2013	179	2.8 (1)	193	2.8 (0.9)		73.4%	0[-0.2,0.2]
Subtotal ***	**248**		**259**			**100%**	**0.04[-0.14,0.21]**
Heterogeneity: Tau^2=0; Chi^2=0.49, df=1(P=0.48); I^2=0%							
Test for overall effect: Z=0.42(P=0.67)							
Test for subgroup differences: Chi^2=3.87, df=1 (P=0.05), I^2=74.14%							



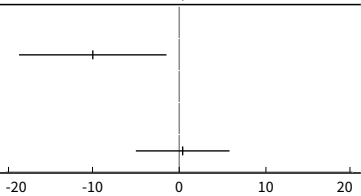
Analysis 4.2. Comparison 4 Quality of Life (physical), Outcome 2 Physical functioning.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.2.1 Educational intervention						
Baraz 2014	45	70.2 (13.4)	45	68.6 (22.8)		1.52[-6.21,9.25]
4.2.2 Behavioural counselling						
Li 2014b	69	53.9 (12.9)	66	51.5 (12.5)		2.4[-1.88,6.68]



Analysis 4.3. Comparison 4 Quality of Life (physical), Outcome 3 Role-physical.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.3.1 Educational intervention						
Baraz 2014	45	50.5 (18.9)	45	60.5 (22.1)		-9.97[-18.48,-1.46]
4.3.2 Behavioural counselling						
Li 2014b	69	20.8 (16.9)	66	20.4 (15.1)		0.4[-5,5.8]



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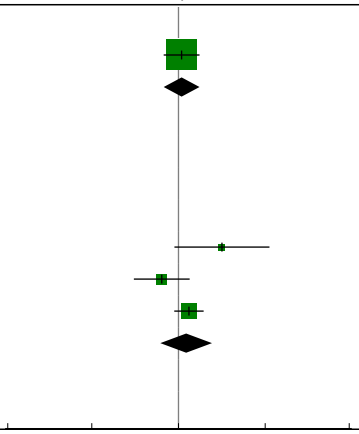
Analysis 4.4. Comparison 4 Quality of Life (physical), Outcome 4 Pain.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
4.4.1 Educational intervention							
Baraz 2014	45	55.5 (29.1)	45	53.2 (32.3)		100%	0.07[-0.34,0.49]
Subtotal ***	**45**		**45**			**100%**	**0.07[-0.34,0.49]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.34(P=0.73)							
4.4.2 Behavioural counselling							
iDiD 2016	13	-1.6 (0.8)	5	-2.6 (1.3)		19.3%	1[-0.09,2.1]
Reilly-Spong 2015	18	39.9 (13.9)	20	44.7 (10.4)		33.69%	-0.39[-1.03,0.26]
Li 2014b	69	64.2 (18.2)	66	59.7 (18.9)		47.01%	0.24[-0.1,0.58]
Subtotal ***	**100**		**91**			**100%**	**0.18[-0.42,0.77]**
Heterogeneity: Tau^2=0.17; Chi^2=5.25, df=2(P=0.07); I^2=61.94%							
Test for overall effect: Z=0.58(P=0.56)							



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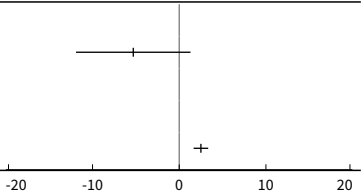
Analysis 4.5. Comparison 4 Quality of Life (physical), Outcome 5 Physical Component Score (PCS).

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.5.1 Behavioural counselling						
Reilly-Spong 2015	17	33.2 (9.8)	19	38.5 (10.4)		-5.3[-11.9,1.3]
4.5.2 Clinical decision-aid						
Cooney 2015	1070	39.3 (9.8)	1129	36.8 (10.3)		2.5[1.66,3.34]



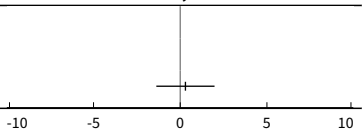
Better with control | Better with eHealth

Analysis 4.6. Comparison 4 Quality of Life (physical), Outcome 6 Burden (KDQoL).

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.6.1 Behavioural counselling						
Li 2014b	69	21.5 (11.7)	66	21.1 (12.2)		0.4[-3.64,4.44]

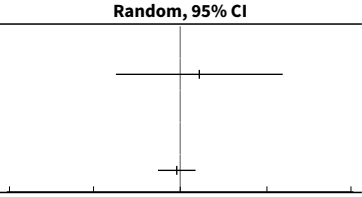
Better with control | Better with eHealth

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.6.2 Clinical decision-aid						
Cooney 2015	1070	89.7 (20.5)	1129	89.4 (19.6)		0.3[-1.38,1.98]



Analysis 4.7. Comparison 4 Quality of Life (physical), Outcome 7 Effects (KDQoL).

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
4.7.1 Behavioural counselling						
Li 2014b	69	63.2 (14.2)	66	62.1 (14.3)		1.1[-3.71,5.91]
4.7.2 Clinical decision-aid						
Cooney 2015	1070	94.2 (11.9)	1129	94.4 (14)		-0.2[-1.28,0.88]

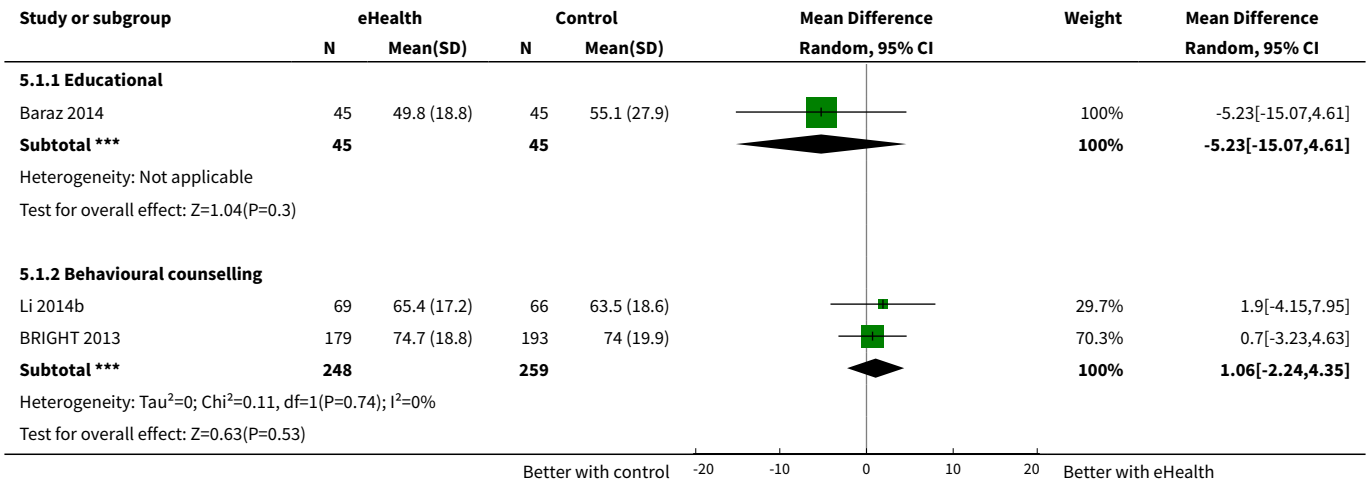


Comparison 5. Quality of Life (mental)

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
1 Mental Health (SF-36)	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Educational	1	90	Mean Difference (IV, Random, 95% CI)	-5.23 [-15.07, 4.61]
1.2 Behavioural counselling	2	507	Mean Difference (IV, Random, 95% CI)	1.06 [-2.24, 4.35]
2 Social functioning (SF-36)	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Educational	1	90	Mean Difference (IV, Random, 95% CI)	3.68 [-4.45, 11.81]
2.2 Behavioural counselling	2	506	Mean Difference (IV, Random, 95% CI)	1.94 [-3.35, 7.22]
3 Fatigue	4		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
3.1 Educational	1	90	Std. Mean Difference (IV, Random, 95% CI)	-0.40 [-0.81, 0.02]
3.2 Behavioural counselling	3	546	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.05, 0.28]
4 Anxiety	4		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
4.1 Behavioural counselling	4		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

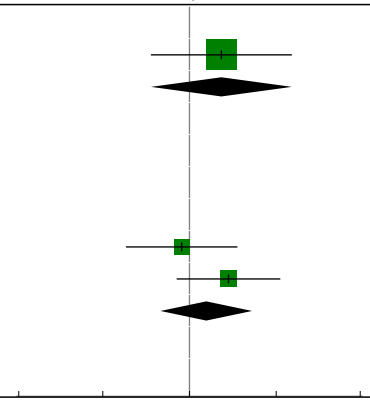
Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
5 Depression	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
5.1 Behavioural counselling	3		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6 Sleep	2		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
6.1 Behavioural counselling	2	186	Std. Mean Difference (IV, Random, 95% CI)	0.07 [-0.55, 0.69]
7 Role-emotional	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
7.1 Education	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8 Mental Component Score (MCS)	2		Mean Difference (IV, Random, 95% CI)	Totals not selected
8.1 Behavioural counselling	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8.2 Clinical decision-aid	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Analysis 5.1. Comparison 5 Quality of Life (mental), Outcome 1 Mental Health (SF-36).



Analysis 5.2. Comparison 5 Quality of Life (mental), Outcome 2 Social functioning (SF-36).

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
5.2.1 Educational							
Baraz 2014	45	67.7 (20.1)	45	64.1 (19.2)		100%	3.68[-4.45,11.81]
Subtotal ***	**45**		**45**			**100%**	**3.68[-4.45,11.81]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.89(P=0.37)							
5.2.2 Behavioural counselling							
Li 2014b	69	42.5 (19.3)	66	43.4 (18.8)		47.49%	-0.9[-7.33,5.53]
BRIGHT 2013	177	73.2 (28.2)	194	68.7 (30.5)		52.51%	4.5[-1.47,10.47]
Subtotal ***	**246**		**260**			**100%**	**1.94[-3.35,7.22]**
Heterogeneity: Tau^2=4.56; Chi^2=1.45, df=1(P=0.23); I^2=31.27%							
Test for overall effect: Z=0.72(P=0.47)							



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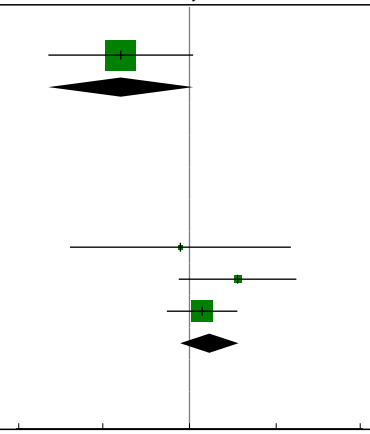
Analysis 5.3. Comparison 5 Quality of Life (mental), Outcome 3 Fatigue.

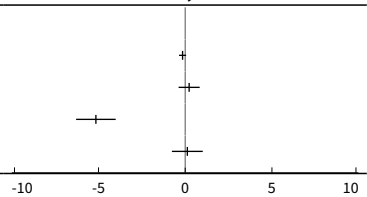
Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
5.3.1 Educational							
Baraz 2014	45	48.9 (15)	45	56.1 (20.6)		100%	-0.4[-0.81,0.02]
Subtotal ***	**45**		**45**			**100%**	**-0.4[-0.81,0.02]**
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%							
Test for overall effect: Z=1.86(P=0.06)							
5.3.2 Behavioural counselling							
Reilly-Spong 2015	18	-57 (6.3)	20	-56.6 (8.4)		6.97%	-0.05[-0.69,0.58]
Li 2014b	69	48.4 (17.7)	66	43.3 (18.9)		24.58%	0.28[-0.06,0.62]
BRIGHT 2013	179	52.4 (22)	194	50.8 (21.8)		68.45%	0.07[-0.13,0.28]
Subtotal ***	**266**		**280**			**100%**	**0.11[-0.05,0.28]**
Heterogeneity: Tau^2=0; Chi^2=1.31, df=2(P=0.52); I^2=0%							
Test for overall effect: Z=1.33(P=0.18)							



Better with control — Better with eHealth

Analysis 5.4. Comparison 5 Quality of Life (mental), Outcome 4 Anxiety.

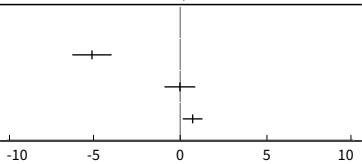
Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
5.4.1 Behavioural counselling						
BRIGHT 2013	179	4.6 (3.7)	194	5.2 (4.1)		-0.15[-0.36,0.05]
Reilly-Spong 2015	20	41.2 (15.3)	22	38.1 (11.6)		0.23[-0.38,0.83]
Kargar Jahromi 2016	27	8.7 (0.9)	27	16.7 (2)		-5.15[-6.29,-4.01]
iDiD 2016	16	4.4 (4.1)	7	3.9 (3.6)		0.12[-0.77,1.01]



Better with eHealth — Better with usual care

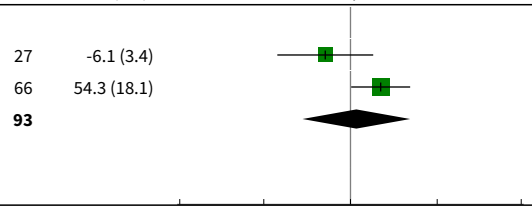
Analysis 5.5. Comparison 5 Quality of Life (mental), Outcome 5 Depression.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
5.5.1 Behavioural counselling						
Kargar Jahromi 2016	27	9 (1.2)	27	16.2 (1.6)		-5.09[-6.22,-3.96]
iDiD 2016	16	7.5 (5.4)	7	7.6 (4.7)		-0.02[-0.91,0.87]
Reilly-Spong 2015	24	14.7 (9.4)	27	9.1 (5.8)		0.72[0.15,1.28]



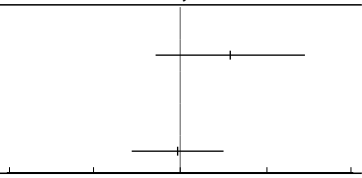
Analysis 5.6. Comparison 5 Quality of Life (mental), Outcome 6 Sleep.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
5.6.1 Behavioural counselling							
Reilly-Spong 2015	24	-7.3 (4.7)	27	-6.1 (3.4)		43.94%	-0.29[-0.84,0.26]
Li 2014b	69	61.1 (20.6)	66	54.3 (18.1)		56.06%	0.35[0.01,0.69]
Subtotal ***	**93**		**93**			**100%**	**0.07[-0.55,0.69]**
Heterogeneity: Tau^2=0.15; Chi^2=3.72, df=1(P=0.05); I^2=73.14%							
Test for overall effect: Z=0.21(P=0.83)							



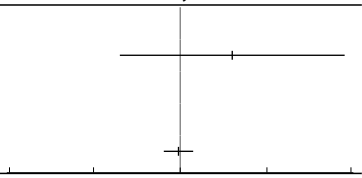
Analysis 5.7. Comparison 5 Quality of Life (mental), Outcome 7 Role-emotional.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
5.7.1 Education						
Baraz 2014	45	50.5 (21.9)	45	44.8 (19.7)		5.77[-2.84,14.38]
5.7.2 Behavioural counselling						
Li 2014b	69	56.3 (14.8)	66	56.6 (16.5)		-0.3[-5.6,5]



Analysis 5.8. Comparison 5 Quality of Life (mental), Outcome 8 Mental Component Score (MCS).

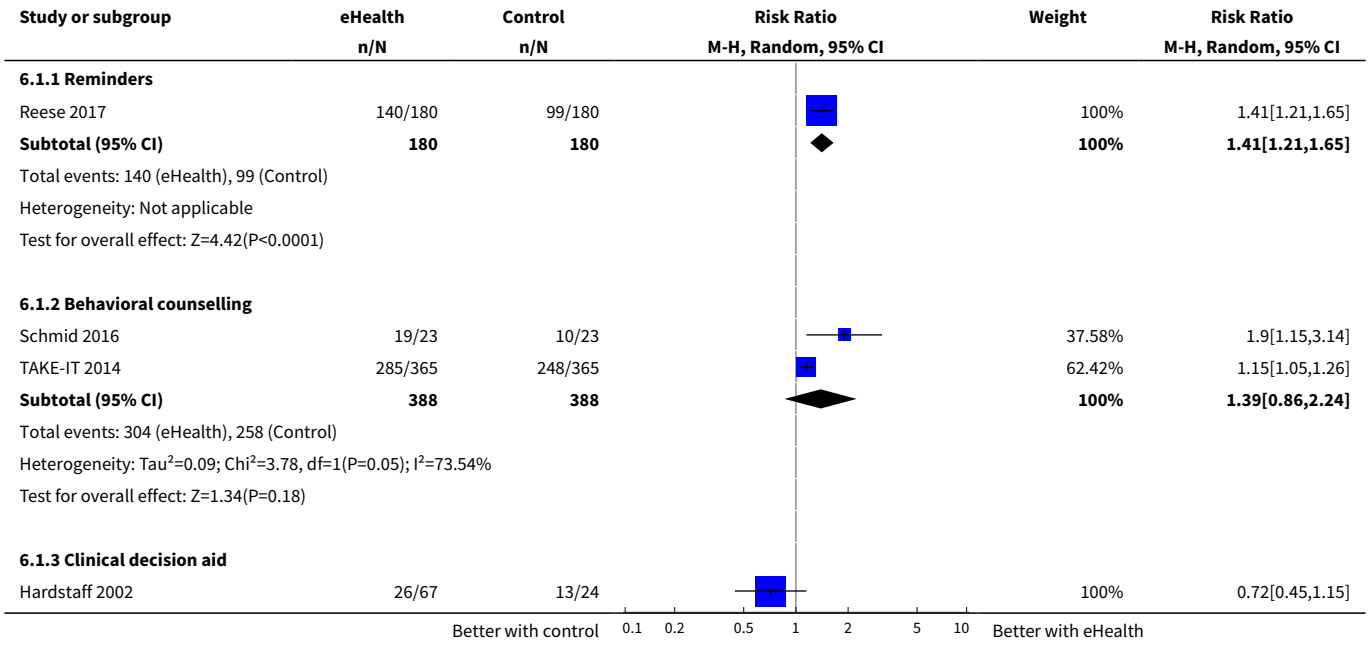
Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
5.8.1 Behavioural counselling						
Reilly-Spong 2015	17	49.7 (10)	19	46.7 (9.8)		3[-3.48,9.48]
5.8.2 Clinical decision-aid						
Cooney 2015	1070	52 (10.6)	1129	52.1 (9.6)		-0.1[-0.95,0.75]

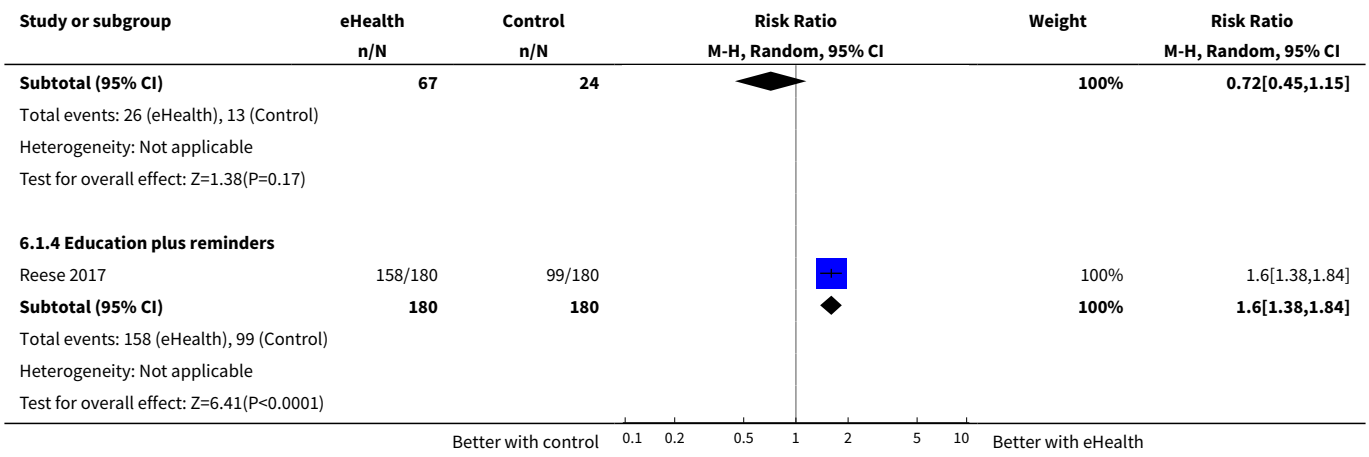


Comparison 6. Medication adherence

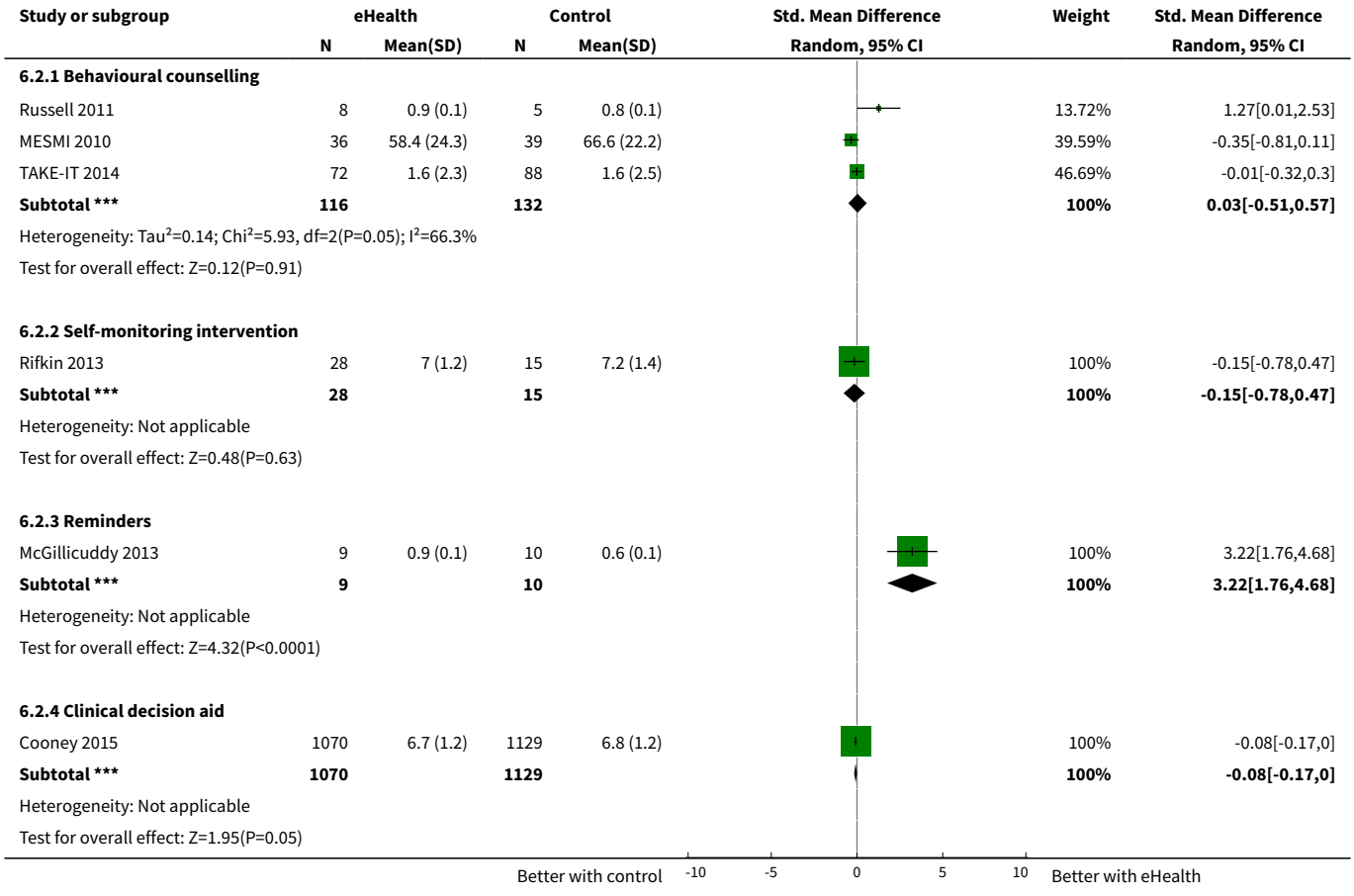
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Medication adherence (dichotomous)	4		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Reminders	1	360	Risk Ratio (M-H, Random, 95% CI)	1.41 [1.21, 1.65]
1.2 Behavioral counselling	2	776	Risk Ratio (M-H, Random, 95% CI)	1.39 [0.86, 2.24]
1.3 Clinical decision aid	1	91	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.45, 1.15]
1.4 Education plus reminders	1	360	Risk Ratio (M-H, Random, 95% CI)	1.60 [1.38, 1.84]
2 Medication adherence (continuous)	6		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Behavioural counselling	3	248	Std. Mean Difference (IV, Random, 95% CI)	0.03 [-0.51, 0.57]
2.2 Self-monitoring intervention	1	43	Std. Mean Difference (IV, Random, 95% CI)	-0.15 [-0.78, 0.47]
2.3 Reminders	1	19	Std. Mean Difference (IV, Random, 95% CI)	3.22 [1.76, 4.68]
2.4 Clinical decision aid	1	2199	Std. Mean Difference (IV, Random, 95% CI)	-0.08 [-0.17, 0.00]

Analysis 6.1. Comparison 6 Medication adherence, Outcome 1 Medication adherence (dichotomous).





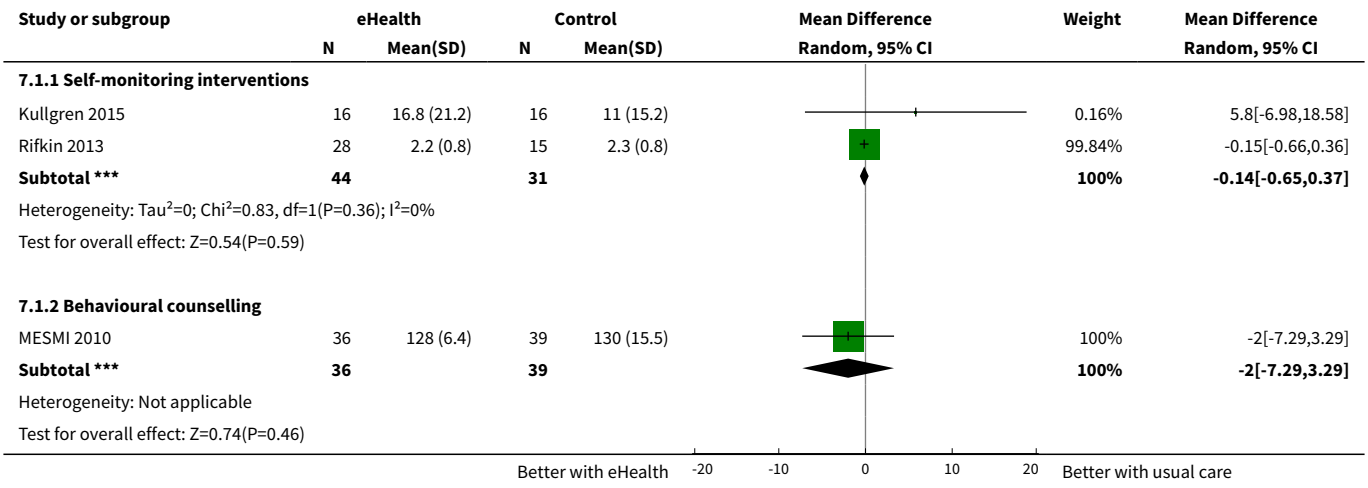
Analysis 6.2. Comparison 6 Medication adherence, Outcome 2 Medication adherence (continuous).



Comparison 7. Change in serum creatinine

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in serum creatinine	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Self-monitoring interventions	2	75	Mean Difference (IV, Random, 95% CI)	-0.14 [-0.65, 0.37]
1.2 Behavioural counselling	1	75	Mean Difference (IV, Random, 95% CI)	-2.0 [-7.29, 3.29]

Analysis 7.1. Comparison 7 Change in serum creatinine, Outcome 1 Change in serum creatinine.

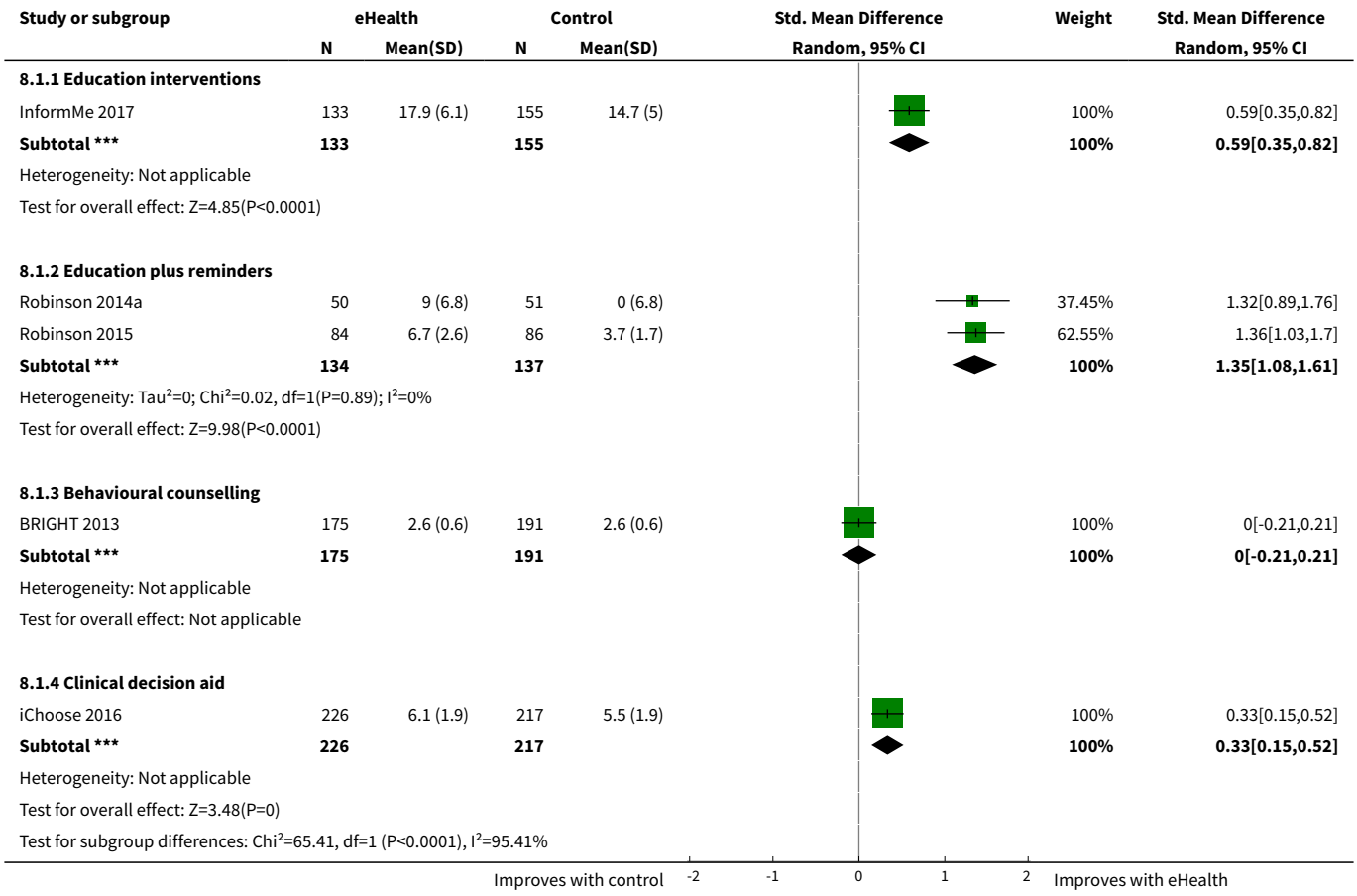


Comparison 8. Knowledge

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in knowledge (continuous)	5		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Education interventions	1	288	Std. Mean Difference (IV, Random, 95% CI)	0.59 [0.35, 0.82]
1.2 Education plus reminders	2	271	Std. Mean Difference (IV, Random, 95% CI)	1.35 [1.08, 1.61]
1.3 Behavioural counselling	1	366	Std. Mean Difference (IV, Random, 95% CI)	0.0 [-0.21, 0.21]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.4 Clinical decision aid	1	443	Std. Mean Difference (IV, Random, 95% CI)	0.33 [0.15, 0.52]

Analysis 8.1. Comparison 8 Knowledge, Outcome 1 Change in knowledge (continuous).



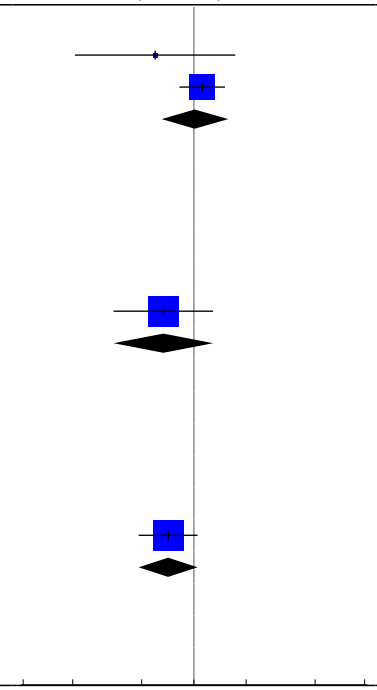
Comparison 9. Hospitalisation rate

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hospitalisation rate (dichotomous)	4		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Behavioural counselling	2	735	Risk Ratio (M-H, Random, 95% CI)	1.01 [0.65, 1.58]
1.2 Clinical decision aid	1	730	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.34, 1.29]
1.3 Reminders	1	106	Risk Ratio (M-H, Random, 95% CI)	0.71 [0.48, 1.05]

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
2 Hospitalisations (continuous)	3		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.1 Self-monitoring interventions	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Education	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Behavioural counselling	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

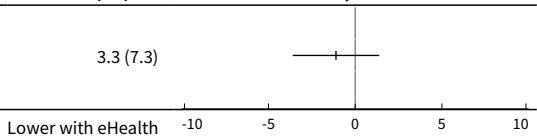
Analysis 9.1. Comparison 9 Hospitalisation rate, Outcome 1 Hospitalisation rate (dichotomous).

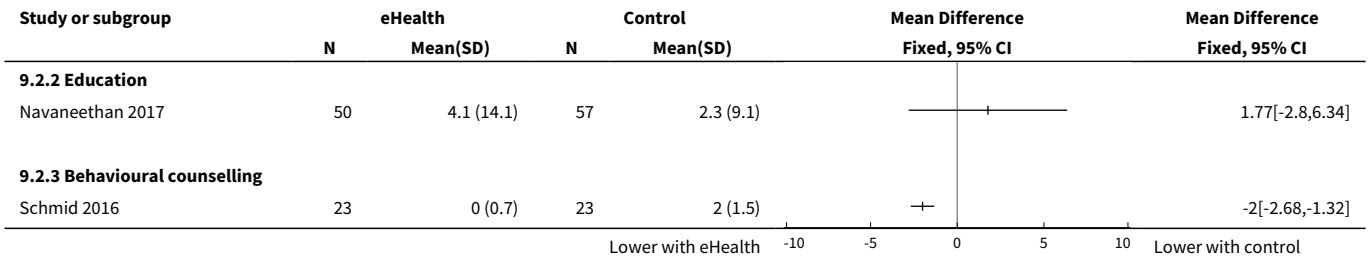
Study or subgroup	eHealth n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
9.1.1 Behavioural counselling					
Li 2014b	5/69	8/66		15.35%	0.6[0.21,1.73]
Ishani 2016	134/450	40/150		84.65%	1.12[0.83,1.51]
Subtotal (95% CI)	**519**	**216**		**100%**	**1.01[0.65,1.58]**
Total events: 139 (eHealth), 48 (Control)					
Heterogeneity: Tau²=0.04; Chi²=1.23, df=1(P=0.27); I²=18.68%					
Test for overall effect: Z=0.06(P=0.95)					
9.1.2 Clinical decision aid					
Durand 2000	14/365	21/365		100%	0.67[0.34,1.29]
Subtotal (95% CI)	**365**	**365**		**100%**	**0.67[0.34,1.29]**
Total events: 14 (eHealth), 21 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.2(P=0.23)					
9.1.3 Reminders					
Henriksson 2016	22/53	31/53		100%	0.71[0.48,1.05]
Subtotal (95% CI)	**53**	**53**		**100%**	**0.71[0.48,1.05]**
Total events: 22 (eHealth), 31 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.72(P=0.09)					



Analysis 9.2. Comparison 9 Hospitalisation rate, Outcome 2 Hospitalisations (continuous).

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
9.2.1 Self-monitoring interventions						
Schulz 2007	43	2.2 (5.5)	58	3.3 (7.3)		-1.11[-3.61,1.39]

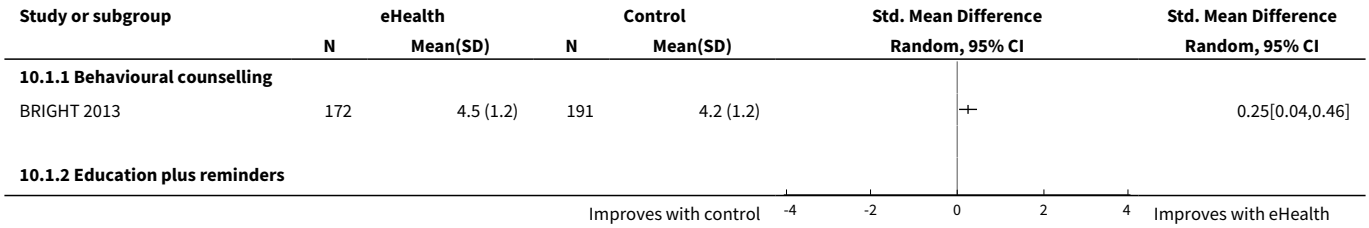




Comparison 10. Behavioural outcomes

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Self-care behaviours	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 Behavioural counselling	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 Education plus reminders	2		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2 Attitudes towards performing a behaviour	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 Education plus reminders	2		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 Self-monitoring intervention	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Willingness to perform behaviour	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 Educational intervention	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 Education plus reminders	2		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Analysis 10.1. Comparison 10 Behavioural outcomes, Outcome 1 Self-care behaviours.



Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
Robinson 2015	84	57.7 (13.1)	86	31.1 (4.9)		2.7[2.28,3.11]
Robinson 2014a	50	12.5 (19.6)	51	2.5 (17.5)		0.53[0.14,0.93]
				Improves with control	-4 -2 0 2 4	Improves with eHealth

Analysis 10.2. Comparison 10 Behavioural outcomes, Outcome 2 Attitudes towards performing a behaviour.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
10.2.1 Education plus reminders						
Robinson 2014a	50	7 (12)	51	0 (8.5)		0.67[0.27,1.07]
Robinson 2015	84	6.6 (3.9)	86	1.1 (0.7)		1.99[1.62,2.36]
10.2.2 Self-monitoring intervention						
Welch 2013	16	39.8 (4.5)	17	40.1 (4.9)		-0.06[-0.75,0.62]
				Improves with control	-4 -2 0 2 4	Improves with eHealth

Analysis 10.3. Comparison 10 Behavioural outcomes, Outcome 3 Willingness to perform behaviour.

Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
10.3.1 Educational intervention						
InformMe 2017	133	2.5 (1.5)	155	2.8 (1.2)		-0.2[-0.44,0.03]
10.3.2 Education plus reminders						
Robinson 2014a	50	-8 (25)	51	0 (34.5)		-0.26[-0.65,0.13]
Robinson 2015	84	-74.6 (21.4)	86	-22.6 (1.7)		-3.43[-3.91,-2.96]
				Improves with eHealth	-4 -2 0 2 4	Improves with control

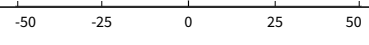
Comparison 11. Blood pressure

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Systolic blood pressure	5		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Self-monitoring intervention	2	144	Mean Difference (IV, Random, 95% CI)	-2.68 [-8.34, 2.99]
1.2 Behavioural counselling	1	75	Mean Difference (IV, Random, 95% CI)	-3.90 [-12.40, 4.60]
1.3 Reminder systems	1	17	Mean Difference (IV, Random, 95% CI)	-24.20 [-36.41, -11.99]

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
1.4 Clinical decision aids	1	947	Mean Difference (IV, Random, 95% CI)	0.70 [-1.53, 2.93]
2 Diastolic blood pressure	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Self-monitoring intervention	2	144	Mean Difference (IV, Random, 95% CI)	1.56 [-1.56, 4.69]
2.2 Behavioural counselling	1	75	Mean Difference (IV, Random, 95% CI)	0.85 [-3.07, 4.77]
3 BP within guideline recommendations	5		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Behavioural counselling	2	577	Risk Ratio (M-H, Random, 95% CI)	1.19 [1.03, 1.37]
3.2 Clinical decision-aid	1	870	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.87, 1.19]
3.3 Reminder systems	1	17	Risk Ratio (M-H, Random, 95% CI)	4.5 [0.63, 32.38]
3.4 Education	1	107	Risk Ratio (M-H, Random, 95% CI)	0.97 [0.86, 1.09]

Analysis 11.1. Comparison 11 Blood pressure, Outcome 1 Systolic blood pressure.

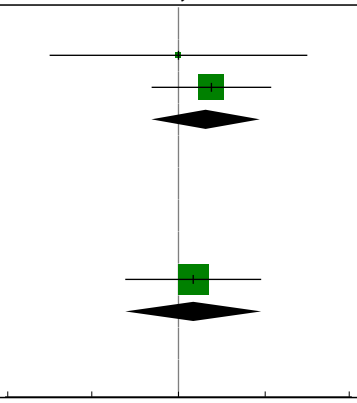
Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
11.1.1 Self-monitoring intervention							
Rifkin 2013	28	136 (15.6)	15	140 (14.4)		37.09%	-4[-13.3,5.3]
Schulz 2007	43	116 (17)	58	117.9 (19.5)		62.91%	-1.9[-9.04,5.24]
Subtotal ***	**71**		**73**			**100%**	**-2.68[-8.34,2.99]**
Heterogeneity: Tau^2=0; Chi^2=0.12, df=1(P=0.73); I^2=0%							
Test for overall effect: Z=0.93(P=0.35)							
11.1.2 Behavioural counselling							
MESMI 2010	36	-6.9 (20.5)	39	-3 (16.7)		100%	-3.9[-12.4,4.6]
Subtotal ***	**36**		**39**			**100%**	**-3.9[-12.4,4.6]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.9(P=0.37)							
11.1.3 Reminder systems							
McGillicuddy 2013	8	131.1 (10.5)	9	155.3 (15)		100%	-24.2[-36.41,-11.99]
Subtotal ***	**8**		**9**			**100%**	**-24.2[-36.41,-11.99]**
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%							
Test for overall effect: Z=3.89(P=0)							
11.1.4 Clinical decision aids							
Cooney 2015	474	135.1 (17.4)	473	134.4 (17.6)		100%	0.7[-1.53,2.93]
Subtotal ***	**474**		**473**			**100%**	**0.7[-1.53,2.93]**



Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Heterogeneity: Not applicable							
Test for overall effect: Z=0.62(P=0.54)							

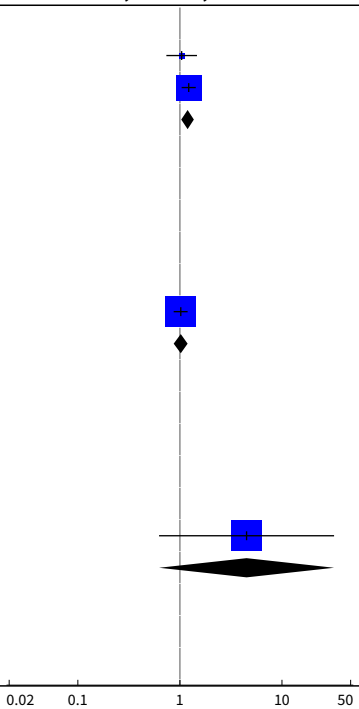
Analysis 11.2. Comparison 11 Blood pressure, Outcome 2 Diastolic blood pressure.

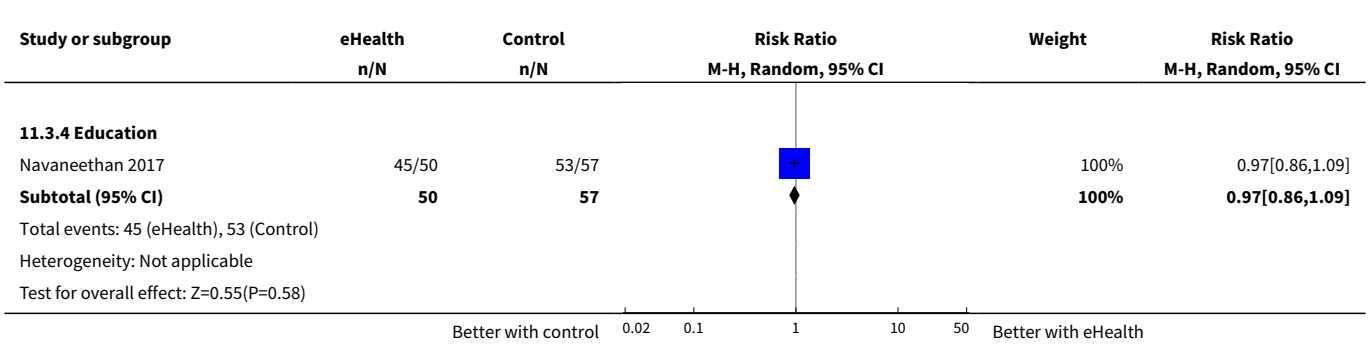
Study or subgroup	eHealth N	eHealth Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
11.2.1 Self-monitoring intervention							
Rifkin 2013	28	73 (10.3)	15	73 (12.6)		17.72%	0[-7.43,7.43]
Schulz 2007	43	66.9 (8.7)	58	65 (8.8)		82.28%	1.9[-1.55,5.35]
Subtotal ***	**71**		**73**			**100%**	**1.56[-1.56,4.69]**
Heterogeneity: Tau^2=0; Chi^2=0.21, df=1(P=0.65); I^2=0%							
Test for overall effect: Z=0.98(P=0.33)							
11.2.2 Behavioural counselling							
MESMI 2010	36	-2.2 (8.7)	39	-3.1 (8.6)		100%	0.85[-3.07,4.77]
Subtotal ***	**36**		**39**			**100%**	**0.85[-3.07,4.77]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.43(P=0.67)							



Analysis 11.3. Comparison 11 Blood pressure, Outcome 3 BP within guideline recommendations.

Study or subgroup	eHealth n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
11.3.1 Behavioural counselling					
Ishani 2016	72/135	20/39		17.12%	1.04[0.74,1.47]
BRIGHT 2013	130/193	116/210		82.88%	1.22[1.04,1.43]
Subtotal (95% CI)	**328**	**249**		**100%**	**1.19[1.03,1.37]**
Total events: 202 (eHealth), 136 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0.69, df=1(P=0.41); I^2=0%					
Test for overall effect: Z=2.36(P=0.02)					
11.3.2 Clinical decision-aid					
Cooney 2015	185/441	177/429		100%	1.02[0.87,1.19]
Subtotal (95% CI)	**441**	**429**		**100%**	**1.02[0.87,1.19]**
Total events: 185 (eHealth), 177 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.21(P=0.84)					
11.3.3 Reminder systems					
McGillicuddy 2013	4/8	1/9		100%	4.5[0.63,32.38]
Subtotal (95% CI)	**8**	**9**		**100%**	**4.5[0.63,32.38]**
Total events: 4 (eHealth), 1 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.49(P=0.14)					





ADDITIONAL TABLES

Table 1. Overview of characteristics of included studies

Total studies (participants)	**43 (6617)**	
	No. studies	**% studies**
Country		
Australia	1	2%
North America	26	60%
UK	5	12%
Europe	6	14%
Middle East	3	7%
Asia	2	5%
Number of participants		
0-50	17	40%
51-100	10	23%
101-200	10	23%
201-300	3	7%
300+	3	7%
Length of intervention		
≤ 1 week	4	9%
1-3 months	16	37%
4-6 months	9	21%
> 6 months	13	30%

Table 1. Overview of characteristics of included studies *(Continued)*

unclear	1	2%
Participant age		
Paediatric (including carers)	4	(9%
Adult (≥ 18 years)	39	(91%
Stage of CKD		
CKD stage 1-5	11	26%
Haemodialysis	10	23%
Peritoneal dialysis	6	14%
Transplant candidates	1	2%
Transplant recipient	15	35%
eHealth modality		
Telehealth	10	23%
Mobile or tablet app	11	26%
Mobile phone text message	2	5%
Electronic monitoring	11	26%
Internet website	4	9%
Video or DVD	2	5%
Mixed methods	3	7%
eHealth intervention category		
Education	4	9%
Reminders	5	12%
Self-monitoring	9	21%
Behavioural counselling	16	37%
Clinical decision-aid	4	9%
Mixed interventions	4	9%
Unclear	1	2%
Publication type		
Abstract or short report	10	23%
Journal article	33	77%

CKD - chronic kidney disease

Table 2. Descriptive analyses of reported outcomes for educational interventions

Outcome Study ID	Outcome measure	Study population (No. of participants); study duration	Results
Behavioural			
Knowledge InformMe 2017	31-item multiple choice test	Adults, kidney transplant candidates (28); 1 week	Intervention: mean 17.94 (SD 6.06) Control: mean 14.7 (SD 5) P = 0.001
Willingness to perform a behaviour InformMe 2017	Willingness to accept an Increased Risk Donor Kidney Lower scores indicate more willingness	Adults, kidney transplant candidates (188); 1 week	Intervention: mean 2.54 (SD 1.45) Control: mean 2.81 (SD 1.2) P = 0.09
Quality of Life			
Fatigue Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD (90); 6 months	Intervention: mean 48.9 (SD 15) Control: mean 56.1 (SD 20.6) P = 0.034
General health perception Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD (90); 6 months	Intervention: mean 41.01 (SD 16.87) Control: mean 48.38 (SD 18.18) P = 0.94
Mental health Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD; (90); 6 months	Intervention: mean 49.84 (SD 18.84) Control: mean 55.07 (SD 27.9) P < 0.001
Pain Baraz 2014	SF-36 Higher scores indicate higher QoL	Adults, HD (90); 6 months	Intervention: mean 55.45 (SD 29.14), Control: mean 53.22 (SD 32.34) P = NS
Physical functioning Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD (90); 6 months	Intervention: mean 70.15 (SD 13.4) Control: mean 68.63 (SD 22.82) P = 0.021
Role (emotional) Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD (90); 6 months	Intervention: mean 50.53 (SD 21.92) Control: mean 44.76 (SD 19.7) P = 0.26
Role (physical) Baraz 2014	SF-36	Adults, HD (90); 6 months	Intervention: mean 50.51 (SD 18.9) Control: mean 60.48 (SD 22.14)

Table 2. Descriptive analyses of reported outcomes for educational interventions *(Continued)*

	Higher scores indicate better QoL		P = 0.031
Social functioning Baraz 2014	SF-36 Higher scores indicate better QoL	Adults, HD (90); 6 months	Intervention: mean 67.74 (SD 20.09) Control: mean 64.06 (SD 19.24) P < 0.001

CI - confidence interval; HD - haemodialysis; QoL - quality of life; RR - risk ratio; SD - standard deviation

Table 3. Descriptive analyses of reported outcomes for reminder interventions

Outcome Study ID	Outcome measure	Study population (No. of participants); study duration	Results
Biochemical parameters			
Phosphate Jammalamadaka 2015	Serum phosphate	Adults, HD (27); 7 days	Intervention: mean 6.00 (SD 1.2) Control: mean 6.19 (SD 0.76) P = 0.76
Blood pressure			
Blood pressure within guideline recommendations McGillicuddy 2013	Blood pressure within pre-specified goals	Adults, kidney transplant recipients (17); 3 months	RR 4.50 (95% CI 0.63, 32.38) P = 0.13
Systolic blood pressure McGillicuddy 2013	Higher readings indicate poorer control	Adults, kidney transplant recipients (17); 3 months	Intervention: mean 131 (SD 10.5) Control: 155.3 (SD 15) P = 0.004
Clinical end-points			
Hospitalisations Henriksson 2016	Unplanned admission rates to hospital or emergency department	Adults, kidney transplant recipients (80); 12 months	RR 0.71 (95% CI 0.48 to 1.05) Intervention: 22/53 events Control: 31/53 events
Rejection episodes Henriksson 2016	Number of rejection episodes	Adults, kidney transplant recipients (80); 12 months	Intervention: 6 rejections in 4 participants Control: 27 rejections in 13 participants)
Rejection episodes Potter 2016	Number of rejection episodes	Adults, kidney transplant recipients (46); 1 year	Intervention: 0/20 Control: 9/26
Medication adherence			

Table 3. Descriptive analyses of reported outcomes for reminder interventions *(Continued)*

Medication adherence McGillicuddy 2013	Measured using electronic medication tray openings	Adults, kidney transplant recipients (19); 3 months	Intervention: mean 0.945 (SD 0.11) Control: mean 0.574 (SD 0.11)

HD - haemodialysis; RR - risk ratio; SD - standard deviation

Table 4. Descriptive analyses of reported outcomes for self-monitoring interventions

Outcome Study ID	Outcome measure	Study population (No. of participants); study duration	Results
Behavioural			
Attitudes towards performing a behaviour Welch 2013	Perceived benefits of fluid adherence Higher score indicates more perceived benefits	Adults, HD (33); 6 weeks	Intervention: mean 39.8 (SD 4.5) Control: mean 40.1 (SD 4.9) P = 0.28
Perceived benefits of sodium adherence Welch 2013	Benefits of sodium adherence Higher score indicates higher perceived benefits	Adults, HD (35); 6 weeks	Intervention: mean 29.9 (SD 4.4) Control: mean 30.3 (SD 4.2) P = 0.77
Perceived control Welch 2013	7-item mastery scale Higher score indicates higher perceived control	Adults, HD (35); 6 weeks	Intervention: mean 28.5 (SD 4.9) Control: mean 23.6 (SD 14.3) P > 0.1
Self-efficacy (diet) Welch 2013	Cardiac diet self-efficacy instrument Higher score indicates higher self-efficacy	Adults, HD (35); 6 weeks	Intervention: mean 32.7 (SD 10.1) Control: mean 31.1 (SD 10.2) P = 0.4
Self-efficacy (fluid) Welch 2013	Fluid Self-Efficacy Scale Higher score indicates higher self-efficacy	Adults, HD (36); 6 weeks	Intervention: mean 41.4 (SD 5.8) Control: mean 43.9 (SD 6.4) P = 0.21
Biochemical parameters			
Kidney function Kullgren 2015	Serum creatinine	Children, kidney transplant recipients (31); 4 weeks	Intervention: mean 16.8 (SD 21.2) Control: mean 11 (SD 15.2) P = 0.53
Kidney function Rifkin 2013	Serum creatinine	CKD stage 3 or greater (43); 6 months	Intervention: mean 2.17 (SD 0.76) Control: mean 2.32 (SD 0.84) P = 0.12

Table 4. Descriptive analyses of reported outcomes for self-monitoring interventions *(Continued)*

Serum sodium Kullgren 2015	% change in serum sodium	Children, kidney transplant recipients (31); 4 weeks	Intervention: median 0 (range -4.86 to 1.45) Control: median -0.72 (range -3.52 to 2.19) P = 0.29
Urea Nitrogen Kullgren 2015	% change in blood urea nitrogen	Children, kidney transplant recipients (31); 4 weeks	Intervention: median -2.38 (range -36.84 to 61.54) Control: median 4.56 (range -31.25 to 107.33) P = 0.78
Blood pressure			
Blood pressure control Rifkin 2013	Mean arterial pressure	CKD stage 3 or greater (43); 6 months	Intervention: mean 93.9 (SD 8.6) Control: mean 95.2 (SD 11.7) P = 0.67
Diastolic blood pressure Rifkin 2013	Higher readings indicate poorer control	CKD stage 3 or greater (43); 6 months	Intervention: mean 73 (SD 10.3) Control: mean 73 (SD 12.6) P = 0.93
Diastolic blood pressure Schulz 2007	Higher readings indicate poorer control	Adults, HD (101); 3 months	Intervention: mean 66.9 (SD 8.7) Control: mean 65 (SD 8.8) P < 0.05
Management of hypertension Rifkin 2013	Number of anti-hypertensive medications	CKD stage 3 or greater (43); 6 months	Intervention: mean 4 (SD 1.2) Control: mean 3.9 (SD 1.3) P = 0.61
Systolic blood pressure Rifkin 2013	Higher readings indicate poorer control	CKD stage 3 or greater (43); 6 months	Intervention: mean 136 (SD 15.6) Control: mean 140 (SD 14.4) P = 0.48
Systolic blood pressure Schulz 2007	Higher readings indicate poorer control	Adults, HD (101); 3 months	Intervention: mean 116 (SD 17) Control: mean 17.9 (SD 19.5) P = NS
Clinical end-points			
Hospitalisations Schulz 2007	Unplanned admission rates to hospital or ED	Adults, HD (101); 3 months	Intervention: mean 2.2 (SD 5.5) Control: mean 3.31 (SD 7.3)
Medication usage Rifkin 2013	Total number of medications	CKD stage 3 or greater (43); 6 months	Intervention: mean 12 (SD 4.6) Control: mean 12.8 (SD 5.1) P = 0.62

Table 4. Descriptive analyses of reported outcomes for self-monitoring interventions *(Continued)*

Sleep duration (minutes) Williams 2017	Fitbit Flex activity tracker	Adults, HD (29); 5 weeks	Intervention: mean 389.9 (SD 69.6) Control: mean 349.8 (SD 80.0) P = NS
Sleep efficiency (%) Williams 2017	Fitbit Flex activity tracker	Adults, HD (29); 5 weeks	Intervention: mean 86.1 (SD 4.6) Control: mean 80.3 (SD 7.1) P < 0.05
Ultrafiltration Schulz 2007	mL/hour during dialysis, weekly average	Adults, HD (101); 3 months	Intervention: mean 621.6 (SD 169.7 mL/hour) Control: mean 652.5 (SD 198.6 mL/hour) P = 0.712
Dietary intake			
Fluid intake Kullgren 2015	3-day fluid log through electronic water bottle	Children, kidney transplant recipients (32); 4 weeks	Unadjusted OR 12.25 (95% CI 1.08 to 138.99) P = 0.043 *Intervention group significantly improved.*
Medication adherence			
Medication adherence Rifkin 2013	Morisky Medication Adherence Scale Higher scores indicate better adherence	CKD stage 3 or greater (43); 6 months	Intervention: mean 7 (SD 1.2) Control: mean 7.2 (SD 1.4) P = 0.58
Physical activity			
Physical activity, distance (km) Williams 2017	FitBit Flex activity tracker	Adults, HD (29); 5 weeks	Intervention: mean 2.3 (SD 1.2) Control: mean 2.2 (SD 0.8) P = NS
Physical activity (steps) Williams 2017	FitBit Flex activity tracker	Adults, HD (29); 5 weeks	Intervention: mean 5365 (SD 2765) Control: mean 5211 (SD 2010) P = NS

CKD - chronic kidney disease; HD - haemodialysis; NS - not significant; OR - Odds ratio; SD - standard deviation

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions

Outcome Study ID	Outcome measure	Study population (No. of participants); study duration	Results
Behavioural			
Illness perception	Brief Illness Perception Questionnaire	Adults, HD (25); 3 months	Intervention: mean 44.2 (SD 12.09)

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

iDiD 2016	Higher score indicates more negative perception of ESKD		Control: mean 41.2 (SD 10.28)
Knowledge BRIGHT 2013	Modified Morisky's Medication Adherence Scale Higher score indicates higher medication knowledge	Adults, ≥ CKD stage 3 ± proteinuria (366); 6 months	Intervention: mean 2.6 (SD 0.6) Control: mean 2.6 (SD 0.6) P = 0.331
Self-care behaviours BRIGHT 2013	Summary of Diabetes Self Care Activities Higher sore indicates higher self-care	Adults, ≥ CKD stage 3 ± proteinuria (374); 6 months	Intervention: mean 4.5 (SD 1.2) Control: mean 4.2 (SD 1.2) P = 0.019
Biochemical parameters			
Kidney function MESMI 2010	Serum creatinine	Adults, CKD, eGFR < 60 mL/min + diabetes (75); 6 months	Intervention: mean 128 (SD 6.4) Control: mean 130 (SD 15.5) P = NS
Kidney function TAKE-IT 2014	Annualised change in eGFR	Adolescents, kidney transplant recipients (169); 12 months	Intervention: median -2.3 (95% CI -10.6 to 10.3) Control: median -3.3 (95% CI -7.7 to 3.7) P = 0.5
Blood pressure			
Blood pressure within guideline recommendations BRIGHT 2013	--	Adults, ≥ CKD stage 3 ± proteinuria (403); 6 months	RR 1.22 (95% CI 1.04 to 1.43) P = 0.002 *Favouring eHealth intervention*
Blood pressure within guideline recommendation Ishani 2016	--	Adults, CKD, eGFR < 60 mL/min (76); 12 months	RR 1.04 (95% CI 0.74 to 1.47) P = 0.8
Diastolic blood pressure MESMI 2010	Higher readings indicate poorer control	Adults, CKD, < eGFR 60 mL/min + diabetes (75); 6 months	Intervention: mean reduction 2.25 (SD 8.7) Control: mean reduction 3.1 (SD 8.6) P = 0.681
Systolic blood pressure MESMI 2010	Higher readings indicate poorer control	Adults, CKD, < eGFR 60 mL/min + diabetes (75); 6 months	Intervention: mean reduction 6.9 (SD 20.5) Control: mean reduction 3 (SD 16.7) P = 0.371
Clinical end-points			

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Adverse events TAKE-IT 2014	including post-transplant lymphoproliferative disorder, Epstein-Barr virus infection, CMV, BK virus infection, influenza, other infection, vomiting/diarrhoea, surgery/procedure, other, hospitalisations	Adolescents, kidney transplant recipients (169); 12 months	Intervention: 12.9 Control: 12.7 P = 0.9
Cholesterol control Ishani 2016	Serum LDL-C < 100 mg/dL	Adults, CKD, eGFR < 60mL/min (76); 12 months	Intervention: 31/61 (51%) Control: 8/15 (53%) P = 0.9
Composite end point Ishani 2016	Death, ED admissions, hospitalisations and admission to skilled nursing facility	Adults, CKD, eGFR < 60 mL/min (600); 12 months	HR 0.98 (95% CI 0.75 to 1.29), P = 0.9 Intervention: 208/450 (46.2%) Control: 70/150 (46.7%)
Diabetes control MESMI 2010	Serum HbA1c	Adults, CKD, eGFR < 60 mL/min + diabetes (75); 6 months	Intervention: median 7.5 (IQR 7 to 8.5) Control: median 7 (IQR 6 to 9)
Diabetes control Ishani 2016	Serum HbA1c < 8%	Adults, CKD, eGFR < 60mL/min (48); 12 months	Intervention: 14/33 (42%) Control: 3/33 (15%) P = 0.6
Graft failure TAKE-IT 2014	--	Adolescents, kidney transplant recipients (169); 12 months	Intervention: 0 Control: 0
Graft rejection, acute TAKE-IT 2014	--	Adolescents, kidney transplant recipients (169); 12 months	Intervention: 1.06 Control: 1.69 P = 0.3
Healthcare utilisation BRIGHT 2013	Service use (Primary health care services, community health, social care, secondary healthcare services, out-of-pocket expenses, costs of loss of productivity)	Adults, ≥ CKD stage 3 ± proteinuria (374); 6 months	Intervention: mean 6.1 (SD 5.5) Control: mean 6.5 (SD 4.7) P = 0.455
Healthcare utilisation Ishani 2016	Admission to skilled nursing facility	Adults, CKD, eGFR < 60mL/min (600); 12 months	HR 3.07 (95% CI 0.71 to 13.24) Intervention: 18/450 (4%) Control: 2/150 (1.3%)
Healthcare utilisation Li 2014b	Clinic visits, 3 or more visits	Adults, PD (135); 12 weeks	Intervention: 3/69 (4.4%) Control: 5/66 (7.6%) P = 0.039
Hospitalisations Schmid 2016	Unplanned admission rates to hospital or ED	Adults, kidney transplant recipients (26); 12 months	Intervention: mean 0 (SD 0.74) Control: mean 2 (SD 1.48)

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Hospitalisations Ishani 2016	Unplanned admission rates to hospital or ED	Adults, CKD, eGFR < 60 mL/min (600); 12 months	RR 1.12 (95% CI 0.83 to 1.51) Intervention: 134/450 events Control: 40/150 events
Hospitalisations Li 2014b	Unplanned admission rates to hospital or ED	Adults, PD (135); 12 weeks	RR 0.60 (95% CI 0.21 to 1.73) Intervention: 5/69 Control: 8/66
Hospitalisations TAKE-IT 2014	--	Adolescents, kidney transplant recipients (169); 12 months	Intervention: 4.96 Control: 5.38 P = 0.7
Kidney function Ishani 2016	Initiation on dialysis	Adults, CKD, eGFR < 60 mL/min (600); 12 months	HR 1.86 (95%CI 0.41 to 8.39), P = NS Intervention: 11/450 (2.4%) Control: 2/150 (1.3%)
Rejection episodes Schmid 2016	Number of rejection episodes	Adults, kidney transplant recipients (46); 12 months	Intervention: 1/23 Control: 2/23
Smoking status Ishani 2016	Number participants quit smoking	Adults, CKD, eGFR < 60 mL/min (52); 12 months	Intervention: 9/40 (23%) Control: 5/12 (42%) P = 0.3
Medication adherence			
Medication adherence Schmid 2016	% compliant according to composite adherence score	Adults, kidney transplant recipients (26); 12 months	RR 1.90 (95% CI 1.15 to 3.14), P = 0.013 Intervention: 19/23 Control: 10/23
Medication adherence MESMI 2010	Pill counts to determine a score	Adults, CKD, eGFR < 6o mL/min + diabetes (75); 6 months	Intervention: mean 58.4 (SD 24.3) control: mean 66.6 (SD 22.2) P = 0.162
Medication adherence Russell 2011	Medication Event Monitoring System used to record opening of bottles	Adults, kidney transplant recipients (13); 6 months	Intervention: mean 0.88 (SD 0.09) Control: mean 0.77 (SD 0.06) P = 0.0396
Medication adherence TAKE-IT 2014	Perfect taking adherence was defined as taking all prescribed daily doses	Adolescents, kidney transplant recipients (169); 12 months	OR 1.50 (95% CI 1.06 to 2.12) *In favour of eHealth intervention*
Medication adherence TAKE-IT 2014	Self-reported using the Medical Adherence Measure Medication Module (MAM-MM)	Adolescents, kidney transplant recipients (169) 12 months	Taking adherence Intervention: 98.3 (SD 4.5)

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

			Control: 97.1 (SD 6.0) P = 0.2 Timing adherence Intervention: 95 (SD 7.9) Control: 92.9 (SD 9.3) P = 0.2
Medication adherence TAKE-IT 2014	Standard deviation of tacrolimus trough concentrations during intervention interval	Adolescents, kidney transplant recipients (169); 12 months	Intervention: 1.6 (CI 0.9 to 2.5) Control: 1.4 (CI 0.9 to 2.1) P = 0.5
Medication motivation BRIGHT 2013	Modified Morisky's Medication Adherence Scale Higher score indicates higher medication motivation	Adults, ≥ CKD stage 3 ± proteinuria (369); 6 months	Intervention: mean 2.7 (SD 0.6) Control: mean 2.7 (SD 0.5) P = 0.568
Dietary intake			
PD dietary problems Koprucki 2010	Self-reported questionnaire Unclear whether higher or lower scores represent an improvement in dietary problems	Adults, PD (19); 4 months	Intervention: mean -10.5 points (SD 16.2) Control: mean +0.5 points (SD 20.1) P = 0.194
Quality of Life			
Anxiety BRIGHT 2013	Hospital Anxiety and Depression Scale (HADS-A) Higher score indicate more anxiety	Adults, ≥ CKD stage 3 ± proteinuria (345); 6 months	Intervention: mean 4.6 (SD 3.7) Control: mean 5.2 (SD 4.1) P = 0.06
Anxiety iDiD 2016	Generalised Anxiety Disorder questionnaire Higher score indicate more anxiety	Adults, HD (25); 3 months	Intervention: mean 4.4 (SD 4.1) Control: mean 3.9 (SD 3.6)
Anxiety Kargar Jahromi 2016	Depression Anxiety Stress Scales (DASS) Higher scores indicate worse anxiety	Adults, HD (54); 1 month	Intervention: mean 8.68 (SD 0.9) Control: mean 16.72 (SD 1.98) P = 0.01
Anxiety Reilly-Spong 2015	State-Trait Anxiety Inventory Higher scores indicate worse anxiety	Adults, kidney transplant recipients (42); 2 months	Intervention: mean 41.2 (SD 15.3) Control: mean 38.1 (SD 11.6) P = 0.55
Burden Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 21.5 (SD 11.7) Control: mean 21.1 (SD 12.2) P = 0.86

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Cognitive function Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 74.2 (SD 15.7) Control: mean 76.8 (SD 16.5) P = 0.35
Depression iDiD 2016	Patient Health Questionnaire – 9 Higher scores indicate more depressive symptoms	Adults, HD (23); 3 months	Intervention: mean 7.5 (SD 5.4) Control: mean 7.6 (SD 4.7)
Depression Kargar Jahromi 2016	Depression Anxiety Stress Scales (DASS) Higher scores indicate worse anxiety	Adults, HD (54); 1 month	Intervention: mean 8.96 (SD .17) Control: mean 16.2 (SD 1.6)
Depression Reilly-Spong 2015	Center for Epidemiologic Studies Depression Scale Higher score indicate more symptoms	Adults, kidney transplant recipients (51) 2 months	Intervention: mean 14.7 (SD 9.4) Control: mean 9.1 (SD 5.8) P = 0.05
Effects Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 63.2 (SD 14.2) Control: mean 62.1 (SD 14.3) P = 0.63
Emotional well-being BRIGHT 2013	heiQ Higher score indicates higher negative affect	Adults, ≥ CKD stage 3 ± proteinuria (374); 6 months	Intervention: mean 31.4 (SD 22.2) Control: mean 34 (SD 22.2) P = 0.329
Fatigue BRIGHT 2013	Medical Outcomes Survey, energy and vitality Higher score indicates more energy and vitality	Adults, ≥ CKD stage 3 ± proteinuria (373); 6 months	Intervention: mean 52.4 (SD 22) Control: mean 50.8 (SD 21.8) P = 0.082
Fatigue Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 6 weeks	Intervention: mean 48.4 (SD 17.7) Control: mean 43.3 (SD 18.9) P = 0.02
Fatigue Reilly-Spong 2015	Patient-Reported Outcomes Measurement Information System – Fatigue Higher score indicate more symptoms	Adults, kidney transplant recipients (38); 2 months	Intervention: mean 57 (SD 6.3) Control: mean 56.6 (SD 8.4) P = 0.65
General health perception BRIGHT 2013	SF-36 Higher scores indicate higher QoL	Adults, ≥ CKD stage 3 ± proteinuria (372); 6 months	Intervention: mean 2.8 (SD 1.0) Control: 2.8 (SD 0.9) P = 0.832
General health perception	KDQoL-SF	Adults, PD (135); 12 weeks	Intervention: mean 38.2 (SD 17.5)

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Li 2014b	Higher scores indicate higher QoL		Control: mean 35.7 (SD 17.7) P = 0.41
Health services navigation BRIGHT 2013	Health Education Impact Questionnaire	Adults, ≥ CKD stage 3 ± proteinuria (372); 6 months	Intervention: mean 70.5 (SD 16.2) Control: mean 69.4 (SD 15.9) P = 0.226
Hope Poorgholami 2016a	Miller's questionnaire of hope Higher score indicates greater hopefulness	Adults, HD (75); 2 months	Intervention: mean 187.0 (SD 11.46) Control 1: mean 170.96 (SD 7.99) Control 2: mean 91.16 (SD 11.06) P < 0.05 *Significant improvement in the intervention group compared to both control groups*
Loneliness BRIGHT 2013	UCLA Loneliness Scale Higher score indicates lower loneliness	Adults, ≥ CKD stage 3 ± proteinuria (369); 6 months	Intervention: mean 30.3 (SD 5.3) Control: mean 31 (SD 4.4) P = 0.861
Mental component score Reilly-Spong 2015	SF-12 Higher score indicates higher quality of life	Adults, kidney transplant recipients (63); 2 months	Intervention: mean 49.7 (SD 10) Control: mean 46.7 (SD 9.8) P = 0.01
Mental health BRIGHT 2013	Medical Outcomes Survey, psychological well being Higher score indicates higher psychological well being	Adults, ≥ CKD stage 3 ± proteinuria (372); 6 months	Intervention: mean 74.7 (SD 18.8) Control: mean 74 (SD 19.9) P = 0.286
Mental health Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 6 weeks	Intervention: mean 65.4 (SD 17.2) Control: mean 63.5 (SD 18.6) P = 0.77
Mobility iDiD 2016	EQ-5D Higher score indicates reduced mobility	Adults, HD (25); 3 months	Intervention: mean 1.5 (SD 0.8) Control: mean 2.4 (SD 1.5) P = NS
Mood iDiD 2016	EQ-5D Higher score indicates lower mood	Adults, HD (25); 3 months	Intervention: mean 1.5 (SD 0.8) Control: mean 2.0 (SD 1.0)
Quality of life (global score) BRIGHT 2013	EQ-5D Higher scored indicates reduced quality of life	Adults, CKD ≥ stage 3 ± proteinuria (372); 6 months	Intervention: mean 0.71 (SD 0.28) Control: mean 0.67 (SD 0.29) P = 0.027
Physical component score	SF-12	Adults, kidney transplant recipients (63); 2 months	Intervention: mean 33.2 (SD 9.8)

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Reilly-Spong 2015	Higher score indicates higher quality of life		Control: mean 38.5 (SD 10.4) P =0.96
Physical functioning Li 2014b	KDQoL-SF Higher scores indicate higher QoL	Adults, PD (135); 12 weeks	Intervention: mean 53.9 (SD 12.9) Control: mean 51.5 (SD 12.5) P = 0.28
Pain iDiD 2016	EurQoL EQ-5D Higher scores indicate more pain	Adults, HD (18); 3 months	Intervention: mean 1.6 (SD 0.8) Control: mean 2.6 (SD 1.3) P = NS
Pain Li 2014b	KDQoL-SF Higher scores indicate less pain	Adults, PD (135); 12 weeks	Intervention: mean 64.2 (SD 18.2) Control: mean 59.7 (SD 18.9) P = 0.16
Pain Reilly-Spong 2015	SF-12 Higher scores indicate less pain	Adults, kidney transplant recipients (38); 2 months	Intervention: mean 39.9 (SD 13.9) Control: 44.7 (SD 10.4) P = 0.94
Patient satisfaction Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 75.9, SD 13.8 Control: mean 71.3 (SD 12.3) P = 0.04
Positive and active engagement in life BRIGHT 2013	heiQ Higher score indicates higher engagement with life	Adults, ≥ CKD stage 3 ± proteinuria (374); 6 months	Intervention: mean 66.4 (SD 19.7) Control: mean 66.5 (SD 17.6) P = 0.999
Quality social interaction Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 73.2 (SD 15.1) Control: mean 71.7 (SD 14.1) P = 0.56
Role, emotional Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 6 weeks	Intervention: mean 56.3 (SD 14.8) Control: mean 56.6 (SD 16.5) P = 0.77
Role, physical Li 2014b	KDQoL-SF Higher scores indicate higher QoL	Adults, PD (135); 12 weeks	Intervention: mean 20.8 (SD 16.9) Control: mean 20.4 (SD 15.1) P = 0.91
Self-monitoring and insight BRIGHT 2013	heiQ Higher score indicates higher self-monitoring and insight	Adults, ≥ CKD stage 3 ± proteinuria (374); 6 months	Intervention: mean 70.7 (SD 12.2) Control: mean 70.7 (SD 11.5) P = 0.644

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Sexual function Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 83.7 (SD 16.4) Control: mean 78.4 (SD 15.5) P = 0.05
Side effects from corticosteroids, cardiac and kidney dysfunction Schmid 2016	End-stage renal disease symptom checklist (ESRD-SCL) Higher score indicate improved quality of life	Adults, kidney transplant recipients (46); 12 months	Intervention: median 0 (IQR 0.2) Control: median 0.4 (IQR 0.6) P = 0.004
Skills and technique acquisition BRIGHT 2013	heiQ Higher score indicates higher skills and technique acquisition	Adults, ≥ CKD stage 3 ± proteinuria (369); 6 months	Intervention: mean 65.4 (SD 14.6) Control: mean 65.0 (SD 13.1) P = 0.218
Social network (illness) BRIGHT 2013	heiQ Higher score = greater help with illness from social network	Adults, ≥ CKD stage 3 ± proteinuria (342); 6 months	Intervention: mean 10.3 (SD 8.4) Control: mean 11.5 (SD 9) P = 0.208
Social network (practical) BRIGHT 2013	heiQ Higher score = greater help with practical work from social network	Adults, ≥ CKD stage 3 ± proteinuria (342); 6 months	Intervention: mean 6.2 (SD 6.2) Control: mean 8.1 (SD 7.1) P = 0.017
Social support Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 74.1 (SD 14.7) Control: mean 73.2 (SD 15.1) P = 0.73
Self-care iDiD 2016	EQ-5D Higher score indicates reduced self-care	Adults, HD (25); 3 months	Intervention: mean 1.2 (SD 0.6) Control: mean 1.4 (SD 0.9) P = NS
Sleep Li 2014b	KDQoL-SF Higher score indicates better sleep	Adults, PD (160); 6 weeks	Intervention: mean 61.1 (SD 20.6) Control: mean 54.3 (SD 18.1) P = 0.1
Sleep Reilly-Spong 2015	Pittsburgh Sleep Quality Index Lower score indicates better sleep quality	Adults, kidney transplant recipients (63); 2 months	Intervention: mean 7.3 (SD 4.7) Control: 6.1 (SD 3.4) P = 0.65
Social capital BRIGHT 2013	heiQ Higher score indicates increased satisfaction with opportunities to participate in the community	Adults, ≥ CKD stage 3 ± proteinuria (366); 6 months	Intervention: mean 3.7 (SD 0.8) Control: mean 3.6 (SD 0.8) P = 0.325

Table 5. Descriptive analyses of reported outcomes for behavioural counselling interventions *(Continued)*

Social integration BRIGHT 2013	heiQ Higher score indicates higher social integration	Adults, ≥ CKD stage 3 ± proteinuria (371); 6 months	Intervention: mean 69.6 (SD 20.3) Control: mean 69.4 (SD 15.6) P = 0.537
Social network (emotional) BRIGHT 2013	heiQ Higher score indicates greater help with emotional work from social network	Adults, ≥ CKD stage 3 ± proteinuria (345); 6 months	Intervention: mean 13.4 (SD 10.4) Control: mean 14.9 (SD 11.4) P = 0.463
Social functioning BRIGHT 2013	Medical Outcomes Survey, social/role activities limitations Higher score indicates lower social limitation	Adults, ≥ CKD stage 3 ± proteinuria (371(; 6 months	Intervention: mean 73.2 (SD 28.2) Control: mean 68.7 (SD 30.5) P = 0.492
Social functioning Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 6 weeks	Intervention: mean 42.5 (SD 19.3) Control: mean 43.4 (SD 18.8) P = 0.43
Staff encouragement Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 87.3 (SD 12.8) Control: mean 81.2 (SD 15.1) P = 0.01
Stress Kargar Jahromi 2016	Depression Anxiety Stress Scales (DASS) Higher score indicates higher stress	Adults, HD (54); 1 month	Intervention: mean 8.36 (SD 1.03) Control: mean 13.76 (SD 1.44) P = 0.001
Symptoms/problems Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 72.8 (SD 15) Control: mean 68.6 (SD 6.2) P = 0.08
Usual activities iDiD 2016	EQ-5D Higher scores indicate reduced ability to complete usual activities	Adults, HD (25); 3 months	Intervention: mean 1.5 (SD 0.8) Control: mean 2.8 (SD 1.3) P = NS
Work status Li 2014b	KDQoL Higher scores indicate improved quality of life	Adults, PD (135); 12 weeks	Intervention: mean 17.3 (SD 11.6) Control: mean 14.8 (SD 9.9) P = 0.19

CI - confidence interval; CKD - chronic kidney disease; eGFR - estimated glomerular filtration rate; HD - haemodialysis; HR - hazard ratio; IQR - interquartile range; NS - not significant; PD - peritoneal dialysis; RR - risk ratio; SD - standard deviation

Table 6. Descriptive analyses of reported outcomes for clinical-decision aid interventions

Outcome Study ID	Outcome measure	Study population (No. of participants); study duration	Results
Behavioural			
Knowledge iChoose 2016	9 item scale, unvalidated	Adults, ESKD (443); 1 clinic appointment	Intervention: mean 6.11 (SD 1.91) Control: mean 5.48 (SD 1.87) P < 0.001
Biochemical parameters			
Serum parathyroid hormone Cooney 2015	--	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: 502/1070 (46.9%) Control: 182/1129 (16.1%) P < 0.001
Serum phosphate Cooney 2015	--	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: 680/1070 (63.6%) Control: 527/1129 (46.7%) P < 0.001
Blood pressure			
Blood pressure within guideline recommendations Cooney 2015	--	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (947); 12 months	RR 1.02 (95% CI 0.87 to 1.19) P = 0.84
Management of hypertension Cooney 2015	Number of anti-hypertensive medications	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	0 medications Intervention: 37 (7.8%), control: 65 (13.7%) 1 medication Intervention 52 (11%), control: 63 (13.3%) 2 medications Intervention 128 (27%), control: 105 (22.2%) 3 medications Intervention: 135 (28.5%), control: 121 (25.6%) 4+ medications Intervention: 122 (25.7%), control: 119 (25.2%)
Systolic blood pressure Cooney 2015	Higher readings indicate poorer control	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (947); 12 months	Intervention: mean 135.1 (SD 17.4) Control: mean 134.4 (SD 17.6) P = 0.57

Table 6. Descriptive analyses of reported outcomes for clinical-decision aid interventions *(Continued)*

Clinical end-points			
Access to kidney transplantation iChoose 2016	Composite score of transplant access (at least one of following outcomes: wait-list, deceased, deceased or living donor transplant, 1 living donor inquiry)	Adults, ESKD (443); 1 clinic appointment	Intervention: 168/226 (74.3%) Control: 155/216 (71.4%)
Healthcare utilisation Durand 2000	Frequency of planned medical visits	Adults, PD (30); intervention 9.5 months, control 7.8 months	Intervention: 1/41 days Control: 1/33 days
Hospitalisations Durand 2000	--	Adults, PD (30); intervention 9.5 months, control 7.8 months	RR 0.67 (95% CI 0.34 to 1.29) Intervention: 14/365 events Control: 21/365 events
Kidney function Cooney 2015	Urine albumin creatinine ratio	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: 602/1070 (56.3%) Control: 435/1129 (38.5%) P < 0.001
Kidney function Cooney 2015	Progression to ESKD (dialysis or transplantation)	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: 26/1070 (2.4%) Control: 20/1129 (1.8%); P =0.28
Medication usage Cooney 2015	Prescribed appropriate medications	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	ACEI/ARB Intervention: 309/481 (64.2%) Control: 298/483 (61.7%) P = 0.41 Phosphate binder Intervention: 24/107 (22.4%) Control: 19/81 (23.5%) P = 0.87 Vitamin D Intervention: 310/501 (61.9%) Control: 218/416 (52.4%) P = 0.004 Bicarbonate Intervention: 31/132 (24%) Control: 18/137 (13%)

Table 6. Descriptive analyses of reported outcomes for clinical-decision aid interventions *(Continued)*

			P = 0.03
Medication adherence			
Medication adherence Cooney 2015	Morisky Medication Adherence Scale Higher scores indicate better adherence	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: mean 6.7 (SD 1.2) Control: mean 6.8 (SD 1.2) P = 0.7
Medication adherence Hardstaff 2002	Pill counts	Adults, kidney transplant recipients (91)	RR 0.72 (95% CI 0.42 to 1.15) Intervention: 26/67 Control: 13/24
Quality of Life			
Burden Cooney 2015	KDQoL Higher scores indicate improved quality of life	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: mean 89.7 (SD 20.5) Control: mean 89.4 (SD 19.6) P = 0.93
Effects Cooney 2015	KDQoL Higher scores indicate improved quality of life	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: mean 94.2 (SD 11.9) Control: mean 94.4 (SD 14) P = 0.92
Mental component score Cooney 2015	SF-12 Higher score indicates higher quality of life	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: mean 52 (SD 10.6) Control: mean 52.1 (SD 9.6) P = 0.9
Physical component score Cooney 2015	SF-12 Higher score indicates higher quality of life	Adults, eGFR < 45 mL/min or eGFR < 60 mL/min in past 90 days to 2 years (2199); 12 months	Intervention: mean 39.3 (SD 9.8) Control: mean 36.8 (SD 10.3) P = 0.15

ACEi/ARB - angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; eGFR - estimated glomerular filtration rate; ESKD - end-stage kidney disease; PD - peritoneal dialysis; RR - risk ratio; SD - standard deviation

Table 7. Descriptive analyses of reported outcomes for mixed interventions

Outcome Study ID	Outcome measure	Study population (no. of Participants); study duration	Results
Behavioural			
Attitudes towards performing a behaviour	Attitude: importance of sun protection	Adults, kidney transplant recipients (101); 6 weeks	Intervention: mean 7 (SD 12) Control: mean 0 (SD 8.5) P = 0.003

Table 7. Descriptive analyses of reported outcomes for mixed interventions *(Continued)*

Robinson 2014a	Higher score indicates higher importance		
Attitudes towards performing a behaviour Robinson 2015	Attitude: importance of sun protection Higher score indicates higher importance	Adults, kidney transplant recipients (170); 6 weeks	Intervention: mean 6.59 (SD 3.87) Control: mean 1.07 (SD 0.705) P < 0.05
Knowledge Robinson 2014a	Knowledge of skin cancer and sun protection (self-reported, validated tool	Adults, kidney transplant recipients (103); 6 weeks	Intervention: mean 9 (SD 6.75) Control: mean 0 (SD 6.75) P = 0.015
Knowledge Robinson 2015	Knowledge of skin cancer and sun protection (self-reported, validated tool)	Adults, kidney transplant recipients (170); 6 weeks	Intervention: mean 6.66 (SD 2.57) Control: mean 3.67 (SD 1.73) P = 0.04
Self-care behaviours Robinson 2014a	Sun protection performed Higher score indicates more sun protection behaviours performed	Adults, kidney transplant recipients (101); 6 weeks	Intervention: mean 12.5 (SD 19.6) Control: mean 2.5 (SD 17.5) P = 0.013
Self-care behaviours Robinson 2015	Sun protection performed Higher score indicates more sun protection behaviours performed	Adults, kidney transplant recipients (170); 6 weeks	Intervention: mean 57.7 (SD 13.08) Control: mean 31.1 (SD 4.87) P = 0.013
Willingness to perform a behaviour Robinson 2014a	Willingness to use sun protection Higher scores indicate more willingness	Adults, kidney transplant recipients (101); 6 weeks	Intervention: mean 8 (SD 25) Control: mean 0 (SD 34.5) P = 0.137
Willingness to perform a behaviour Robinson 2015	Willingness to use sun protection Higher scores indicate more willingness	Adults, kidney transplant recipients (170); 6 weeks	Intervention: mean 74.64 (SD 21.4) Control: mean 22.64 (SD 1.65) P = 0.09
Biochemical parameters			
Kidney function Navaneethan 2017	Measurement of serum creatinine	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 42/50 (84%) Control: 57/57 (100%) P = 0.001
Serum parathyroid hormone Navaneethan 2017	--	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 22/50 (44%) Control: 33/57 (58%) P = 0.34
Serum phosphate Navaneethan 2017	--	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 28/50 (56%) Control: 39/57 (68%)

Table 7. Descriptive analyses of reported outcomes for mixed interventions *(Continued)*

			P = 0.52
Measurement of 25-hydroxy Vitamin D Navaneethan 2017	--	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 28/50 (56%) Control: 37/57 (65%) P = 0.31
Blood pressure			
Blood pressure within guideline recommendations Navaneethan 2017	--	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	RR 0.97 (95% CI 0.86 to 1.09) P = 0.98
Clinical end-points			
Cholesterol control Navaneethan 2017	Measurement of serum LDL-C	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 39/50 (78%) Control: 48/57 (84%) P = 0.36
Diabetes control Navaneethan 2017	Measurement of serum HbA1c	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 19/29 (79%) Control: 29/29 (100%) P = 0.02
Hospitalisations Navaneethan 2017	Unplanned admission rates to hospital or emergency department	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: mean 4.06 (SD 14.11) Control: mean 2.29 (SD 9.09) P = 0.24
Kidney function Navaneethan 2017	Urine albumin creatinine ratio	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 19/50 (38%) Control: 25/57 (44%) P = 0.13
Kidney function Navaneethan 2017	Progression to ESKD (dialysis or transplantation)	Adults, CKD, eGFR 15 to 45 mL/min (209); 24 months	Intervention: 4/50 (844%) Control: 1/57 (1.8%) P = 0.36
Melanin index Robinson 2014a	Spectrophotometry, right upper arm with sun protection	Adults, kidney transplant recipients (101); 6 weeks	Intervention: median -0.8 (range: -110 to 186) Control: median 5 (range: -193 to 108) P = 0.497
Melanin index Robinson 2014a	Spectrophotometry, right forearm with sun exposure	Adults, kidney transplant recipients (101); 6 weeks	Intervention: median 16.3 (range -113 to 132) Control: median 44 (range -56 to 317) P = 0.036

Table 7. Descriptive analyses of reported outcomes for mixed interventions *(Continued)*

Melanin index Robinson 2014a	Spectrophotometry, cheek with sun exposure	Adults, kidney transplant recipients (101); 6 weeks	Intervention: median -1 (range: -59 to 240) Control: median 15 (range: -63 to 246) P = 0.114
Sun damage Robinson 2014a	Personnel assessment, right forearm	Adults, kidney transplant recipients (101); 6 weeks	Intervention: median 0 (range: -4 to 2) Control: median 2 (range: -5 to 8) P = 0.031
Medication adherence			
Medication adherence Reese 2017	Serum tacrolimus	Adults, kidney transplant recipients (117); 6 months	Intervention 1: mean 8.7 (SD 2.7) Intervention 2: mean 8.08 (SD 1.56) Control: mean 8.38 (SD 1.67) P = 0.4
Medication adherence Reese 2017	Co-efficient of variation for tacrolimus levels	Adults, kidney transplant recipients (117); 6 months	Intervention 1: mean 0.23 (SD 0.18) Intervention 2: mean 0.21 (SD 0.15) Control: mean 0.24 (SD 0.15) P = 0.7
Medication adherence Reese 2017	% tacrolimus levels within range	Adults, kidney transplant recipients (117); 6 months	Intervention 1: mean 0.35 (SD 0.32) Intervention2: mean 0.37 (SD 0.26) Control: mean 0.42 (SD 0.3) P = 0.6
Medication adherence Reese 2017	% of days bottles opened at correct times	Adults, kidney transplant recipients (117); 6 months	RR 1.41 (95% CI 1.21 to 1.65); P < 0.00 Intervention 1: 140/180 Intervention 2: 158/180 Control: 99/180

CI - confidence interval; CKD - chronic kidney disease; eGFR - estimated glomerular filtration rate; ESKD - end-stage kidney disease; RR - risk ratio; SD - standard deviation

APPENDICES

Appendix 1. Electronic search strategies

Database	Search terms
CENTRAL	1. MeSH descriptor: [Kidney Diseases] explode all trees 2. MeSH descriptor: [Renal Replacement Therapy] explode all trees

(Continued)

	3. MeSH descriptor: [Renal Insufficiency] explode all trees 4. MeSH descriptor: [Renal Insufficiency, Chronic] explode all trees 5. dialysis:ti,ab,kw (Word variations have been searched) 6. hemodialysis or haemodialysis:ti,ab,kw (Word variations have been searched) 7. hemofiltration or haemofiltration:ti,ab,kw (Word variations have been searched) 8. hemodiafiltration or haemodiafiltration:ti,ab,kw (Word variations have been searched) 9. kidney disease* or renal disease* or kidney failure or renal failure:ti,ab,kw (Word variations have been searched) 10.ESRF or ESKF or ESRD or ESKD:ti,ab,kw (Word variations have been searched) 11.CKF or CKD or CRF or CRD:ti,ab,kw (Word variations have been searched) 12.CAPD or CCPD or APD:ti,ab,kw (Word variations have been searched) 13.predialysis or pre-dialysis:ti,ab,kw (Word variations have been searched) 14.{or #1-#13} 15.(sms or mms) and messag*:ti,ab,kw (Word variations have been searched) 16.apps:ti,ab,kw (Word variations have been searched) 17.text messag*:ti,ab,kw (Word variations have been searched) 18.multimedia messag*:ti,ab,kw (Word variations have been searched) 19.facebook*:ti,ab,kw (Word variations have been searched) 20.email*:ti,ab,kw (Word variations have been searched) 21.twitter* or tweet*:ti,ab,kw (Word variations have been searched) 22.social media*:ti,ab,kw (Word variations have been searched) 23.(mobile* or cell or smart*) and phone*:ti,ab,kw (Word variations have been searched) 24.ios or android:ti,ab,kw (Word variations have been searched) 25.ipad* or iphone* or ipod*:ti,ab,kw (Word variations have been searched) 26.tablet* and computer*:ti,ab,kw (Word variations have been searched) 27.(online or web*) and (education* or train*):ti,ab,kw (Word variations have been searched) 28.personal digital assistant*:ti,ab,kw (Word variations have been searched) 29.e-health or ehealth or mhealth or m-health or telehealth or telemedicine:ti,ab,kw (Word variations have been searched) 30.{or #15-#29} 31.{and #14, #30}
MEDLINE	1. exp Telemedicine/ 2. exp Internet/ 3. exp communications media/ 4. exp Programmed Instruction as Topic/ 5. Computers, Handheld/ 6. Mobile Applications/ 7. exp Cell Phones/ 8. ((sms or mms) and messag$).tw. 9. apps.tw. 10."text messag$".tw. 11.multimedia messag$.tw. 12.facebook.tw. 13.email$.tw. 14.(twitter or tweet$).tw. 15.social media$.tw. 16.((mobile$ or cell or smart$) and phone).tw. 17.(ios or android$).tw. 18.(ipad$ or iphone$ or ipod$).tw. 19.(tablet$ and computer$).tw. 20.((online or web$) and (education$ or train$)).tw.

(Continued)

	21.personal digital assistant$.tw. 22.(e-health or ehealth or mhealth or m-health or telehealth$ or telemedicine$).tw. 23.or/1-22 24.Kidney Diseases/ 25.exp Renal Replacement Therapy/ 26.Renal Insufficiency/ 27.exp Renal Insufficiency, Chronic/ 28.dialysis.tw. 29.(hemodialysis or haemodialysis).tw. 30.(hemofiltration or haemofiltration).tw. 31.(hemodiafiltration or haemodiafiltration).tw. 32.(kidney disease* or renal disease* or kidney failure or renal failure).tw. 33.(ESRF or ESKF or ESRD or ESKD).tw. 34.(CKF or CKD or CRF or CRD).tw. 35.(CAPD or CCPD or APD).tw. 36.(predialysis or pre-dialysis).tw. 37.or/24-36 38.and/23,37
EMBASE	1. exp telehealth/ 2. exp mass communication/ 3. exp mobile application/ 4. ((sms or mms) and messag$).tw. 5. apps.tw. 6. "text messag$".tw. 7. multimedia messag$.tw. 8. facebook.tw. 9. email$.tw. 10.(twitter or tweet$).tw. 11.social media$.tw. 12.((mobile$ or cell or smart$) and phone).tw. 13.(ios or android$).tw. 14.(ipad$ or iphone$ or ipod$).tw. 15.(tablet$ and computer$).tw. 16.((online or web$) and (education$ or train$)).tw. 17.personal digital assistant$.tw. 18.(e-health or ehealth or mhealth or m-health or telehealth$ or telemedicine$).tw. 19.or/1-18 20.exp renal replacement therapy/ 21.kidney disease/ 22.chronic kidney disease/ 23.kidney failure/ 24.chronic kidney failure/ 25.mild renal impairment/ 26.stage 1 kidney disease/ 27.moderate renal impairment/ 28.severe renal impairment/ 29.end stage renal disease/ 30.renal replacement therapy-dependent renal disease/ 31.kidney transplantation/ 32.(hemodialysis or haemodialysis).tw. 33.(hemofiltration or haemofiltration).tw.

(Continued)

34.(hemodiafiltration or haemodiafiltration).tw.
35.dialysis.tw.
36.(CAPD or CCPD or APD).tw.
37.(kidney disease* or renal disease* or kidney failure or renal failure).tw.
38.(CKF or CKD or CRF or CRD).tw.
39.(ESRF or ESKF or ESRD or ESKD).tw.
40.(predialysis or pre-dialysis).tw.
41.((kidney or renal) adj (transplant* or graft* or allograft*)).tw.
42.or/20-41
43.and/19,42

Appendix 2. Risk of bias assessment tool

Potential source of bias	Assessment criteria
Random sequence generation Selection bias (biased allocation to interventions) due to inadequate generation of a randomised sequence	*Low risk of bias:* Random number table; computer random number generator; coin tossing; shuffling cards or envelopes; throwing dice; drawing of lots; minimisation (minimisation may be implemented without a random element, and this is considered to be equivalent to being random).
	High risk of bias: Sequence generated by odd or even date of birth; date (or day) of admission; sequence generated by hospital or clinic record number; allocation by judgement of the clinician; by preference of the participant; based on the results of a laboratory test or a series of tests; by availability of the intervention.
	Unclear: Insufficient information about the sequence generation process to permit judgement.
Allocation concealment Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment	*Low risk of bias:* Randomisation method described that would not allow investigator/participant to know or influence intervention group before eligible participant entered in the study (e.g. central allocation, including telephone, web-based, and pharmacy-controlled, randomisation; sequentially numbered drug containers of identical appearance; sequentially numbered, opaque, sealed envelopes).
	High risk of bias: Using an open random allocation schedule (e.g. a list of random numbers); assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or non-opaque or not sequentially numbered); alternation or rotation; date of birth; case record number; any other explicitly unconcealed procedure.
	Unclear: Randomisation stated but no information on method used is available.
Blinding of participants and personnel Performance bias due to knowledge of the allocated interventions by participants and personnel during the study	*Low risk of bias*: No blinding or incomplete blinding, but the review authors judge that the outcome is not likely to be influenced by lack of blinding; blinding of participants and

(Continued)

	key study personnel ensured, and unlikely that the blinding could have been broken.
	High risk of bias: No blinding or incomplete blinding, and the outcome is likely to be influenced by lack of blinding; blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome is likely to be influenced by lack of blinding.
	Unclear: Insufficient information to permit judgement
Blinding of outcome assessment Detection bias due to knowledge of the allocated interventions by outcome assessors.	*Low risk of bias:* No blinding of outcome assessment, but the review authors judge that the outcome measurement is not likely to be influenced by lack of blinding; blinding of outcome assessment ensured, and unlikely that the blinding could have been broken.
	High risk of bias: No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding; blinding of outcome assessment, but likely that the blinding could have been broken, and the outcome measurement is likely to be influenced by lack of blinding.
	Unclear: Insufficient information to permit judgement
Incomplete outcome data Attrition bias due to amount, nature or handling of incomplete outcome data.	*Low risk of bias:* No missing outcome data; reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias); missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups; for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate; for continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size; missing data have been imputed using appropriate methods.
	High risk of bias: Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups; for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate; for continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size; 'as-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation; potentially inappropriate application of simple imputation.
	Unclear: Insufficient information to permit judgement
Selective reporting Reporting bias due to selective outcome reporting	*Low risk of bias:* The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way; the study protocol is not available

(Continued)

	but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon).
	High risk of bias: Not all of the study's pre-specified primary outcomes have been reported; one or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. sub-scales) that were not pre-specified; one or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect); one or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis; the study report fails to include results for a key outcome that would be expected to have been reported for such a study.
	Unclear: Insufficient information to permit judgement
Other bias Bias due to problems not covered elsewhere in the table	*Low risk of bias:* The study appears to be free of other sources of bias.
	High risk of bias: Had a potential source of bias related to the specific study design used; stopped early due to some data-dependent process (including a formal-stopping rule); had extreme baseline imbalance; has been claimed to have been fraudulent; had some other problem.
	Unclear: Insufficient information to assess whether an important risk of bias exists; insufficient rationale or evidence that an identified problem will introduce bias.

Appendix 3. World Health Organization digital health intervention classifications

Type of intervention	Example of intervention	Studies
1. Targeted client communication	• Alerts or reminders • Targeted health information	Baraz 2014; Cargill 2003; Cooney 2015; Giacoma 1999; Han 2016; Henriksson 2016; iChoose 2016; iDiD 2016; InformMe 2017; Jammalamadaka 2015; Kargar Jahromi 2016; Li 2014b; McGillicuddy 2013; Poorgholami 2016a; Potter 2016; Reese 2017; Reilly-Spong 2015; Robinson 2014a; Robinson 2015; SUBLIME 2016; TAKE-IT 2014
2. Untargeted client communication	• Untargeted information to undefined population	--
3. Client-to-client information	• Peer group	--
4. Personal health tracking	• Client accesses own medical record • Self-monitoring of health data • Active data capture by client	BALANCEWise-HD 2011; BALANCEWise-PD 2011; Durand 2000; Hardstaff 2002; Koprucki 2010; Kullgren 2015; Ong 2017; Rifkin 2013; Schulz 2007; Welch 2013; Williams 2017

(Continued)

5. Citizen based reporting	• Reporting of public health events	--
6. On-demand information services to clients	• Client look-up of health information	Diamantidis 2015
7. Client financial transactions	• Manage out-of-pocket expenses	-

One study could not be classified (Halleck 2017)

Eight studies used multiple strategies (e.g. targeted client communication and personal health tracking) (BalanceWise-HD 2013; BRIGHT 2013; Ishani 2016; MESMI 2010; Navaneethan 2017; Russell 2011; Schmid 2016; Swallow 2016; White 2010)

CONTRIBUTIONS OF AUTHORS

1. Draft the protocol: JS, JC, AW, KC, VL, CC
2. Study selection: JS, ZC
3. Extract data from studies: JS, ZC
4. Enter data into RevMan: JS, ZC
5. Carry out the analysis: JS, ZC
6. Interpret the analysis: JS, ZC
7. Draft the final review: JS, JC, AW, KC, VL, CC
8. Disagreement resolution: VL
9. Update the review: JS

DECLARATIONS OF INTEREST

None known

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

An additional potential harm was added to "Types of outcome measures". "Anxiety due to frequent monitoring" was added to outcomes as this was reported by one study.

The important outcomes listed in the Summary of Findings Table have been changed. A number of the original outcomes listed were either not reported by any study (physical activity) or were too broad to be reported in this format (quality of life). We removed change in electrolyte management, physical activity, adherence to treatment and quality of life from the Summary of Findings table, and added in death as this has been an important outcome to consumers in both HD and transplantation as published by the Song Initiative (SONG 2017).

INDEX TERMS

Medical Subject Headings (MeSH)

*Telemedicine; Disease Progression; Medication Adherence; Quality of Life; Randomized Controlled Trials as Topic; Reminder Systems; Renal Insufficiency, Chronic [*mortality]

MeSH check words

Humans