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A systematic review

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Remote consulting with telemonitoring of CPAP usage data for the routine review of people with Obstructive Sleep Apnoea Hypopnoea Syndrome:

A systematic review

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Abstract

Introduction

Telehealth has the potential to offer more convenient care and reduce travel. We aimed to systematically review studies that assessed the effectiveness of teleconsultation plus telemonitoring in the review of people with Obstructive Sleep Apnoea Hypopnoea Syndrome (OSAHS) receiving Continuous Positive Airway Pressure (CPAP) therapy versus face-to-face care.

Methods

Following Cochrane methodology, we searched 11 electronic databases (November 2015), trial registries, and reference lists of included studies, for trials testing interventions that combined remote consultations with telemonitoring of usage/CPAP data. Outcomes measures were: proportion reviewed, CPAP adherence, symptom control, and satisfaction/acceptability and cost effectiveness.

Results

From 362 potentially relevant papers, we identified five RCTs (n=269 patients): four from North America and one from Spain. Risk of bias was moderate in one, and moderate/high in four trials. Two trials reported number/duration of reviews with inconsistent results. The teleconsultation/telemonitoring improved CPAP adherence in two trials (n=19; n=75); two (n= 114 and n=75) reported no between-groups differences. Two studies, both at moderate/high risk of bias, showed no between-group difference in the Epworth Sleepiness Score. Satisfaction was generally reported positively in all five trials; one trial reported that the teleconsultation/telemonitoring patients were 'more likely to continue' with CPAP treatment. One study reported teleconsultation/telemonitoring as cost effective.

Discussion

The evidence for teleconsultation/telemonitoring in CPAP users is limited; however no safety concerns have been raised. Adequately powered, well-designed trials are needed to establish whether real time telemonitoring and remote teleconsultation is a clinically and cost effective option for people using CPAP therapy.

Systematic review registration: PROSPERO 2015:CRD42015019455.

Keywords

Obstructive sleep apnea hypopnoea syndrome, continuous positive airway pressure, telehealthcare, telemonitoring, remote consulting.

Introduction

Obstructive Sleep Apnoea hypopnoea Syndrome (OSAHS) is a major public health concern and an important cause of morbidity and mortality. (1-7) Epidemiological data reports its prevalence as 3–7% of middle-aged men and 2–5% of women. (2, 4) Globally, prevalence rates are increasing and this is directly related to obesity (2, 8, 9) though a minority of individuals are non-obese. (2, 10, 11) Other contributory factors are; enlarged tongue /tonsillar tissue, excess pharyngeal soft tissue and retro- or micro-gnathia. (12, 13) Quality of life (QoL) is adversely affected. (2, 7) The symptomatic consequences of OSAHS include; excessive daytime sleepiness, loud and socially disruptive snoring, nocturnal choking or gasping, poor unrefreshing sleep, mood changes, impaired alertness (sometimes when driving), morning headaches, nocturia and decreased libido. (2, 8, 11, 13, 14) Driving-related accidents are a particular concern. (1) Work-related performance issues are common, and include incidents or accidents that may result in loss of employment. (1, 7) The increased prevalence of OSAHS in the last two decades has seen an exponential rise in referral rates for investigation and treatment of this condition. (2, 15)

After diagnosis the majority of individuals are established on fixed CPAP therapy (usually following auto-titration to establish therapeutic pressure settings). CPAP can improve morbidity and current guidelines recommend that patients using CPAP should be reviewed regularly to assess adherence, replace disposables such as masks, filters and hoses, manage side effects and maintain CPAP devices. (11, 14) CPAP adherence is problematic for a number of reasons such as mask fit, comfort, prescribed CPAP pressure tolerance, oral-nasal dryness, claustrophobia, abdominal bloating, psychological and social factors. A National Institute for Health and Clinical Excellence technology appraisal reported adherence rates to CPAP therapy as 71% (range 64–83%) in the first year and 79% (range 68–90%) for those who persisted for more than 12 months. (15). However, the definition of CPAP adherence is inconsistent and

reports of CPAP adherence range from as low as 28% to more than 83% in more recent studies. (16, 17) Modern CPAP devices are now able to measure CPAP wear time and efficacy at effective pressure. (17) Low adherence to CPAP limits its therapeutic benefit, (17) and encouraging optimal – or at least adequate - CPAP use is a clinically important (6, 18) but an on-going time consuming problem globally.

Telehealth to support clinical review of CPAP users has the potential to deliver effective and convenient care, (6, 19-23) with possible benefits in terms of therapy adherence, user satisfaction and reduced time taken from employment to attend a specialist sleep centre review. (6) For those living remotely telehealth can reduce travel and can have a significant environmental impact in terms of decreased carbon emissions. (20, 21, 23,)

We aimed to systematically review the literature on the effectiveness, acceptability and health service resource implications of using telehealth (i.e. telemonitoring of CPAP usage data plus remote consultations) to undertake routine reviews of patients using CPAP compared to face-face care in any healthcare setting.

Methods:

Our systematic review is registered with the PROSPERO International prospective register of systematic reviews [CRD42015019455]. (20) We did not make any changes to the protocol and we adhered to the procedures described in the Cochrane Handbook for systematic reviews of interventions, (24) and the PRISMA statement for reporting on systematic reviews. (25) An ethics checklist was submitted to the University of Edinburgh, Centre for Population Health Sciences Research Ethics Group.

Inclusion Criteria:

Our PICOS inclusion/exclusion criteria are summarised in table 1**.** We searched for randomised controlled trials (RCTs), quasi-RCTs and controlled clinical trials (CCTs) in those using CPAP therapy that compared teleconsultation combined with daily telemonitoring of CPAP data with face-to-face care. The interventions had to include both a consultation remote to the main healthcare facility (video or telephone consultation) and the facility for reviewing real-time telemonitoring of data from the CPAP device (defined as data transmitted and monitored by, or available to the reviewing clinical team via a web based platform at any time). We excluded telephone calls without telemonitoring and also telemonitoring without remote consultation. Our interest was in routine reviews of people established on CPAP, as opposed to the coaching and additional support associated with initiation of treatment.

Search strategy:

We searched eleven electronic databases; AMED; British Nursing Index; CINAHL; Cochrane Library; DARE; EMBASE; LILACS; MEDLINE; Web of Science and ZETOC. (Our detailed search strategy is given in supplemental file 1) The bibliographies of included studies were scrutinised to identify possible additional studies and we also hand searched relevant sleep medicine and respiratory journals (*Sleep Medicine*, *Journal of Clinical Sleep Medicine*, *Sleep*, *Sleep Medicine Reviews*, *Thorax*, *European Respiratory Journal*, *Breathe*, *BMJ Open Respiratory Research, Respiratory care, American Journal of Respiratory and Critical Care Medicine*, *Chest*, *European Respiratory Review*, *Respiratory Medicine*, npj*Primary Care Respiratory Medicine*). Search dates were not limited, but we only included studies

published in English as our resources did not permit translation. The search was carried out in November 2015.

Selection of Studies:

An initial sift and rejection of obviously unrelated abstracts was conducted by PM. Titles and abstracts were then screened by PM with 25% checked by HP or BMcK (agreement 100%). In order to ensure that we did not overlook potentially eligible trials we included all abstracts in which any form of telehealth and OSAHS and/or CPAP were explicitly mentioned. The full text of all potentially eligible studies were retrieved and independently assessed against the inclusion criteria by two reviewers (PM, and SL or HP); any disagreements were resolved by team discussion. The selection process was summarised using a PRISMA flow diagram (Figure 1).

Quality assessment:

The methodological quality of included studies was assessed (by PM and HP) using the Cochrane Risk of Bias tool, (24) and the Cochrane Effectiveness and Practice Organisation of Care (EPOC) guidelines. (26) The following seven domain-based parameters were used to assess bias: adequate sequence generation, allocation concealment; blinding of participants and personnel, blinding of outcomes, how incomplete outcome data were addressed, completeness of reporting and freedom from other sources of bias (supplemental file 2). Included studies were given an overall risk of bias and any differences of opinion were resolved by discussion.

Dealing with lack of information:

If after full text assessment it was still unclear whether a study fulfilled the inclusion criteria, or if we

required clarification of any details relating to the intervention, study reporting or outcome data we contacted authors by email for further relevant information.

Data extraction:

We used a piloted data extraction sheet to extract characteristics of included studies under the headings; author and study year, risk of bias, number of participants, country, setting, patient demographics, personnel, arrangements for remote consultation, telemonitoring of CPAP usage data, aspects of care addressed, duration and intensity of intervention, and care provided to the comparator groups (supplemental file 3).

Outcomes:

Primary outcomes were the proportion of patients that received a teleconsultation/telemonitoring review, and recorded adherence with CPAP therapy (by transmission of telemonitoring data). Secondary outcomes of interest were current symptom control (specifically sleepiness scores), patient and clinician acceptability and satisfaction with the teleconsultation/telemonitoring review, and health service resource use/cost compared to face-to-face care.

Data synthesis

We expected that we would identify a limited number of eligible studies (based on our preliminary scoping work) with substantial heterogeneity so that meta-analysis would not be appropriate. We therefore undertook a narrative synthesis of the data.

Results:

362 potentially relevant publications were identified, from which 17 full text articles were reviewed with 12 being excluded (6, 19, 22, 23, 27-35) as they did not match our inclusion criteria which is explained in (supplemental file 4). Five papers fulfilled our inclusion criteria (table 2) Details of the selection process are given in Figure 1 PRISMA flow diagram. Four studies were from North America, (3, 36-38) and one from Spain, (39) and all were based in community settings. The five studies included a total of 269 participants. All the trials included telemonitoring of CPAP adherence; three utilised telephone consultations, (3, 37, 38) the other two utilised teleconferencing for remote consultations. (36, 39)

Description of the study designs:

Four of the included studies were RCTs; (3, 36-38) the other was a CCT. (39) The follow up period in the studies ranged from 1 to 6 months. Four of the trials reported proportion of reviews achieved; outcome measures included CPAP adherence, (3, 36-38) Epworth sleepiness scale, (3, 37) patient/clinician satisfaction/acceptability, (3, 36-39) and costs of providing the telemonitoring / teleconsultation intervention. (36)

Methodological quality:

The results of the methodological quality assessment are detailed in (supplemental file 2). One study was assessed as moderate risk of bias, (38) and four were at moderate-to-high risk of bias. (3, 36, 37, 39) The commonest sources of bias were lack of information regarding sequence generation, allocation concealment, completeness of reporting, no published study protocol, and the inability to blind study personnel to the study intervention.

Description of the interventions:

The characteristics of the included studies are described in detail (supplemental file 3), with a summary in (supplemental file 5). All the interventions were conducted by trained nurses, respiratory or CPAP therapists and physicians. The participants in all five studies had received face-to-face consultations to initiate CPAP therapy prior to entry to the trial.

Telemonitoring of CPAP usage data:

Real time telemonitoring (via a modem) of CPAP adherence and efficacy was included in three studies. (3, 37, 39) Two studies used a home web-connected telemonitoring system (participant activated) with telephone support (36, 38). In all studies, clinical personnel could access and monitor participants and intervene where indicated using predefined pathways.

Teleconsultation for remote review:

Telephone support by the clinical research staff was used to recommend appropriate action where necessary in four studies. (3, 36-38) Comma del Corral *et al* (39) used a video conference system at a remote site hospital with the central base Sleep Research Unit 80 Km away. Smith *et al,* used a home-based telemedicine system with a built in modem and two way camera to allow the study nurses to deliver a structured 12-week CPAP education/support programme (36). In order to mimic the materials and activities of the intervention group, the control group received a 12-week programme on a neutral health topic which discussed the importance of daily vitamin intake. This method was chosen to control for the potential influence of having telehealth in the home and to equalise the Hawthorne effect of being observed through telehealth. (36)

Effectiveness of interventions:

The findings of the studies are summarised in table 2, with further details in supplemental table 4, and synthesised below.

Proportion reviewed:

Two studies reported on number and/or duration of reviews reviewed. Fox *et al* found that an additional hour over the 3-month trial was spent with the telehealth patients compared with the usual care group. (3) In contrast, the teleconsultation/telemonitoring patients in Taylor *et al's* study in new users of CPAP had fewer 'walk-in visits' than the usual care group. (38)

Adherence to CPAP:

In the study at moderate risk of bias (38) which recruited patients with a range of OSAHS severity, adherence to CPAP with teleconsultation/telemonitoring was similar to usual care even though the authors reported that problems with delivery of the telehealth (telephonic communication delays; and delays in delivery of equipment) may have diluted the intervention. Three lower quality studies reported improved CPAP adherence after the teleconsultation/telemonitoring intervention (3, 36, 37) although two were relatively small pilot studies.(36, 37) The controlled clinical trial reported adherence as 75% in the teleconsultation/telemonitoring intervention versus 85% in those who received usual care. (39)

Control of Symptoms:

Two studies (both at moderate to high risk of bias) used the Epworth sleepiness score to record symptom control (3, 37) and the authors found no statistical difference between intervention and control groups. One study also used the Functional Outcome of Sleep Questionnaire (FOSQ) and found no statistically significant differences between intervention and usual care group for any of the component measures of this tool. (37) Two studies did not measure symptom control. (36, 39)

Patient/Clinician Acceptability/Satisfaction:

All five studies reported on satisfaction with teleconsultation/telemonitoring verses face-face care. Four studies, using visual analogue scales (3, 39) or questionnaire ratings (37-39) found no difference in satisfaction between teleconsultation/telemonitoring and usual care. One study (36) (at moderate/high risk of bias) reported on patient acceptability and satisfaction of telemonitoring compared to the control group. The authors undertook thematic analysis of the free text comments on their satisfaction survey; 100% of the surveys in teleconsultation/telemonitoring and 75% in usual care group rated the telehealth sessions positively (no statistical analysis reported); a key theme was that teleconsultation/telemonitoring was helpful in reinforcing the importance of CPAP adherence and they felt more supported with this intervention. None of the studies reported on acceptability to clinicians.

Costs of telehealth:

Smith et al reported that the cost of delivering 14 teleconsultation/telemonitoring sessions for a single participant was $420 compared to $1,500 for face-face visits. (36) Comma del Corral reported on the overall teleconsultation/telemonitoring costs (which included diagnostic testing) but did not report the direct costs associated with delivering the CPAP telehealth review service. (39)

Discussion:

Summary of findings:

The evidence base for the effectiveness of remote consultations with telemonitoring in the clinical review of those using CPAP therapy is limited to two small studies (36, 39) and three larger studies (3, 37, 38), four of which were at moderate to high risk of bias(3, 36, 37, 39) and one at moderate risk if bias. (38) These studies do not provide definitive evidence of effectiveness (in terms of adherence and symptom control) of teleconsultation/telemonitoring in CPAP users; however, there is no suggestion of any harms. The free text comments from a single study suggest that teleconsultation/telemonitoring was well received and perceived as being supportive. (36)

Strengths and limitations:

We searched a wide range of databases and kept our search strategies broad, but we may have missed some studies. A key challenge for the review was the definition our definition of telehealth. We defined this for the purposes of this review as an intervention which included both remote consultation either by telephone or videoconferencing and also the facility for real-time telemonitoring of CPAP data adherence. This meant we rejected interventions (for example) that used remote data on CPAP usage, but expected the patient to travel to follow-up consultations. We recognise, however, that by including the dual requirements of the facility for real-time telemonitoring and remote consultations, we have excluded a number of important studies. Our interest was in studies that facilitated CPAP clinical review and reduced the burden on the patient, and considered that not using remote consultations

obviated an important potential benefit of telehealth. Limited resources meant we were unable to arrange duplicate independent screening at all stages of the selection process, but we undertook duplicate screening of a proportion of the abstracts and after discussion achieved 100% agreement.

Interpretation in the light of published literature:

Telehealth is a rapidly developing field and since we undertook our searches, two potentially relevant studies have been published. Fields *et al* is a prospective, parallel group pilot RCT, (40) which randomised 60 participants to telehealth (real time telemonitoring with telephone review) or usual (face-face) care. This study found no statistical between group differences in CPAP adherence, patient satisfaction, functional outcomes and dropout rates; though those randomised to telemedicine showed greater improvements in mental health scores. Their formal and verbal feedback with all parts of the study were overwhelmingly positive. Reinforcing the findings of this review, the authors concluded that larger scale trials are warranted in order to establish the benefits (or not) of telehealth for OSAHS.

An RCT by Mufano *et al* (n=122) compared a telehealth programme (with real time telemonitoring and telephone support from sleep therapists triggered by responses to automated texts/e-mails) compared to usual care in people newly diagnosed with OSAHS. (41) Reflecting the findings of this review, they found no statistical between group difference in adherence to CPAP therapy or change in Epworth sleep score. However, the telehealth significantly reduced the time spent providing education and coaching making it a time-efficient option.

A number of studies are not included in our systematic review because they did not meet our inclusion criteria which required both the facility for real-time telemonitoring and teleconsultation. (See

supplemental table 2 for details). We regarded both features as important in maximising the benefits of telehealth in OSAHS. Nevertheless these studies may have some lessons of relevance to this review.

Six studies did not have the facility for real-time tele-monitoring of CPAP, (6, 19, 22, 23, 29, 35) though two retrieved the data at the end of the study (6, 23) This may have reduced the potential for the clinicians to detect real time problems in remotely monitored participants such as poor/non adherence; poor mask fit/ leak, and treatment efficacy that could have resulted in clinician intervention to resolve any detected problems. Remote consultations were generally well-received, (6, 19, 23) and one trial found the teleconsultations to be cost effective (travel costs and lost work time were the most important sources of savings). (23)

Adherence remains a major clinical issue for users of CPAP therapy. Echoing the findings of this review, three of the teleconsultation RCTs showed no benefit in terms of adherence, (6, 19, 35) daytime sleepiness, (6) or quality of life. (6) In contrast, Sparrow et al, tested a theoretically based motivational intervention delivered by telephone and showed a significant improvement in adherence, symptoms and functional status, (22) potentially relate to the theoretical approach to behaviour change (42).

Reasons for non-adherence are complex. In an overview of the many factors that influence adherence to CPAP therapy, Shapiro et al (16) cite features of the CPAP device and side effects of treatment; as well as individual patient factors (such as clinical condition, family/home context, socio-economic status, personality, cognitive functioning), the attitude and communication skills of healthcare professionals, availability and efficiency of healthcare services, and national policy and funding of services (16). More directly, the requirements of driving licensing agencies may have an important impact on adherence.. (7) To be successful in promoting long-term adherence, sleep medicine clinicians need to monitor

adherence, educate and coach their patients, and reinforce this education at every clinical review. Access to real-time usage data is a tool to inform discussions about adherence

Implications for research and future practice:

Based on the results of the five trials included in this systematic review the evidence for remote teleconsultation with daily telemonitoring of CPAP usage in OSAHS is far from clear. Well-designed, adequately powered studies are required to clarify the role of teleconsultation combined with real time telemonitoring in the clinical review of people using CPAP therapy. Reflecting the free-text comments in one of the studies, telemonitoring was perceived as reinforcing the importance of adherence, whilst remote consulting has the potential to facilitate convenient reviews especially for those living at a distance from sleep centres. With the emergence of new technologies that enable remote teleconsultation and real time telemonitoring capability in-built into newer CPAP units, there is an opportunity for trials to build on the current evidence base and inform future practice in this area of specialised respiratory medicine.

Conclusions:

The combination of remote consulting and real-time telemonitoring in CPAP therapy users has the potential to offer equivalent care that is more convenient, reduces travel, and is thus environmentally friendly. The technology to implement this model of sleep medicine service delivery is already available and being utilised in many health care settings, and driving research in this area. The limited evidence to date from published trials that have included these interventions has not raised any safety concerns, but adequately powered trials at low risk of bias will be needed to establish whether telehealth (combining remote consultation and real time telemonitoring) is a clinically viable, acceptable and cost effective option for people with OSAHS using CPAP therapy.

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Declaration of Conflicting Interests
The Author(s) declare(s) that there are no conflicts of interest.

Author contributions
Conceived and designed the systematic review: PM, SL, BMcK and HP. Performed the systematic review: PM, SL, BMcK and HP. Analysed the data: PM, SL, BMcK and HP. Wrote the paper: PM, SL, BMcK and HP. PM and HP are guarantors.

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Ethical Approval
A level 1 self-audit checklist was submitted to the University of Edinburgh, Centre for Population Health Sciences Research Ethics Group.

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Table 1: PICOS search strategy

		Definitions
Population	People with a diagnosis of OSAHS on CPAP therapy	Sleep apnoea is defined as a condition in which a person experiences repeated episodes of apnoea because of a narrowing or closure of the pharyngeal airway during sleep (9, 11)
Intervention	The application of telehealth to review people with a diagnosis of OSAHS and using CPAP	This was defined as the use of telehealth to: • review patients remotely (e.g. telephone or video consultation) and • telemonitoring of CPAP usage We excluded telephone calls without telemonitoring and also telemonitoring without remote consultation
Comparator	Usual clinical care without telehealth	Normally delivered face to face but may include some telephone calls (but without telemonitoring of CPAP data)
Outcomes	<u>Primary outcome</u>: Primary outcomes of interest were: • the proportion of patients who had received a telehealth review • adherence with prescribed CPAP therapy. <u>Secondary outcomes</u>: Secondary outcomes of interest included current control of symptoms of OSAHS, patient and clinician acceptability and satisfaction with the telehealth review, and health service resource use/cost implications compared to face-to-face care	CPAP adherence which is typically defined as recorded use of CPAP therapy for > 4 hours per night however details vary between studies Clinical symptoms include validated measures of sleepiness, quality of sleep and quality of life
Setting	Any setting	Typically the patient will be in the community, but the healthcare practitioner may be based in primary or secondary care.
Study design	Randomised controlled trials (RCTs), quasi-RCTs and controlled clinical trials (CCT).	

Figure 1 – Prisma Flow diagram
Systematic review search – OSAHS and Telehealthcare

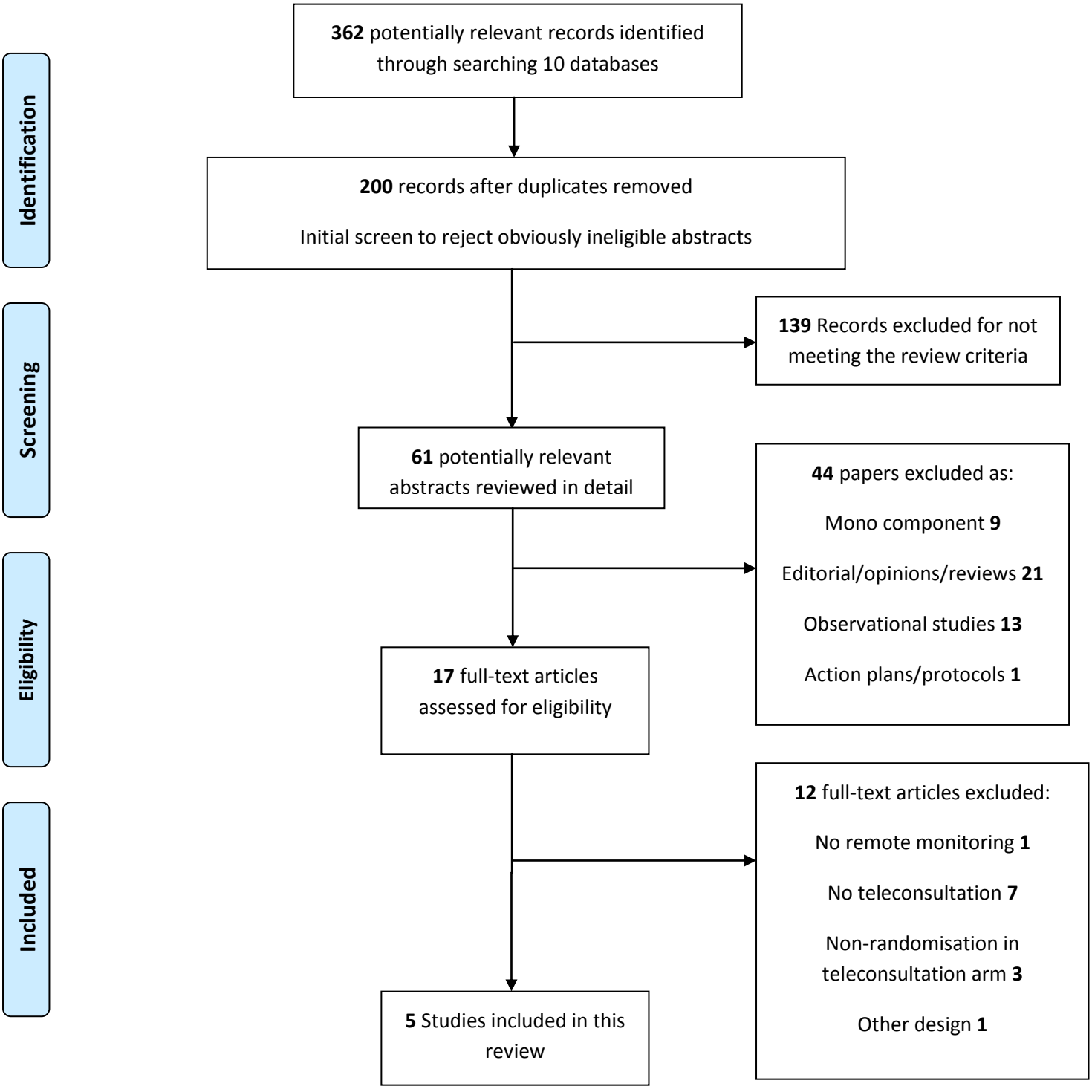

Table 2. Summary of included studies

Reference, Country, Risk of bias (RoB)	Study design, number of participants, Follow-up	Intervention and comparator	Target group Participants	Results					Comments
				Proportion reviewed	Adherence to CPAP	Symptom control	Satisfaction Acceptability	Costs	
Comma del Corral *et al* 2013 *[39]* Spain Mod/high risk RoB	CCT. n= 16 FU: 6m	TH (video consultation + telemonitoring of CPAP usage) vs UC (with CPAP telemonitoring)	Adults with OSAHS Mean age 53yrs 63% male	Not measured	There was no between group difference in adherence to CPAP: Telehealth 75% vs UC 85% (significance not reported)	Not measured	Visual analogue scale used (1-10) reported as 9.5 for both groups Clinician satisfaction not reported	Telemedicine /teleconsultation costs not reported for CPAP users	TH to remote sites feasible; may provide specialised sleep medicine services to geographically distant populations
Fox *et al* 2012 *[3]* Canada Mod/high risk RoB	RCT. n=75 FU: 3m	TH (telemonitoring + telephone support if needed) vs UC (with telephone support where needed)	Adults with OSAHS Mean age 53yrs 80% male	Compared with UC, more time was spent with the TH patients: TH: 210 mins (SD 42) vs UC: 143 min (SD 48) P < 0.0001	Adherence greater in TH group: mean hours /night: TH 3.2 vs UC: 1.8 (p=0.006)	Epworth sleepiness score - no significant between group differences (TH 5.1 vs UC 5.2)	Not measured	Not measured	TH may improve adherence to CPAP at initiation of therapy
Smith *et al* 2006 [*36*] US Mod/high risk	RCT. n=19 FU: 3m	TH **(CPAP)** via telehealth equipment with inbuilt camera enabling clinician	Adults initiating CPAP for OSAHS Mean age	Not measured	TH (CPAP) improved proportion achieving 80% use rate. TH (CPAP): 90% vs	Not measured	Proportion rating service 'positively' TH (CPAP) 100% vs TH (W-B) 75% (significance	TH (CPAP) costs were less than TH (W-B) costs: TH (CPAP): $420 vs TH (W-B) $1,500	Structured **video-consultations** may facilitate problem solving strategies via

RoB		consultation with patients v TH (W-B = well-being advice)	63yrs % male not reported		TH (W-B): 44% (p = 0.033)		not reported)	(significance not reported)	visual camera observation and overcome barriers to adherence
Stepnowsky *et al* 2007 [*37*] US Mod/high risk RoB	RCT. n=45 FU: 2m	TH (regular telemonitoring and telephone calls) vs UC supported by telephone calls	Adults initiating CPAP for OSAHS Mean age 59yrs 98% male	Not measured	Non-significant trend to greater adherence in TH group. Hours/night:4.1 (SD 1.8) vs UC: 2.8 (SD 2.2) (p=0.07)	Epworth sleepiness score. No significant between group difference TH 9.2 (SD 6.6) vs UC 9.9 (SD 5.2) p=0.72	**L**ikelihood of continuing CPAP higher in TH than UC group on score of 1 to 5 (4.8 vs 4.3: P = 0.05)	Not measured	TH monitoring of CPAP adherence with rapid clinician support to guide management may improve adherence and commitment to using CPAP
Taylor *et al* 2006 [*38*] US Mod risk RoB	RCT: n=114 FU: 1m	TH via Health Buddy + daily automated feedback v UC Both groups had telephone support if needed	Adults initiating CPAP for OSAHS Mean age 45yrs 71% male	TH group had fewer 'walk-in visits' than the UC group (1/week vs 3/week) ,	No between group differences in adherence. Hours/night TH: 4.29 (SD 2.15) vs UC: 4.22 (2.05) p=0.87	Modified Functional Outcome of Sleep Q (reported - no differences between TM and UC group	No between group differences in client Satisfaction Questionnaire. TH: 28.5 (SD 3.1) vs UC 28.0 (SD 3.5) p=0.43	Not measured	Very short follow-up (28 days)
Abbreviations: CCT- Controlled Clinical trial, N- Number, FU- Follow up, RCT- Randomised controlled trial, UC- Usual care, m= Month, OSAHS- Obstructive sleep apnoea /hypopnoea syndrome, US- United States, ROB- Risk of bias, CPAP- Continuous positive airway pressure									