A meta-analysis of remote monitoring of heart failure patients
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CRD summary
This review compared remote patient monitoring with usual care in patients with chronic heart failure. The authors found that remote patient monitoring conferred a significant protective clinical effect in patients with chronic heart failure compared with usual care. Publication and language biases were possible and a lack of reporting of study details made the reliability of the authors’ conclusions unclear.

Authors' objectives
To evaluate the efficacy of remote patient monitoring (RPM) compared with usual care in patients with chronic heart failure.

Searching
PubMed, EMBASE, CINHAL, The Cochrane Library and National Guideline Clearinghouse were searched for full-text peer-reviewed articles published in English, Spanish, French, German or Italian between January 2000 and October 2008.

Study selection
Randomised controlled trials (RCTs) or observational cohort studies that evaluated at least two treatment arms and investigated use of telemonitoring compared with usual care in chronic heart failure patients were eligible for inclusion. Usual care referred to in-person visits to the doctor, multidisciplinary outpatient clinics or emergency department without additional phone calls to and from the patient. Remote patient monitoring was defined as: regularly scheduled telephone contact between patients and health care providers (with or without home visits) and reporting of symptoms and/or physiological data; or a technology-assisted monitoring approach with transfer of physiological data collected via remote (at the patient’s home) external monitors or cardiovascular implantable devices. Outcomes considered were: death (any cause); first hospitalisation (any cause); first hospitalisation for heart failure; and a combined end point of first hospitalisation and death from any cause.

Included studies had a female population of 36% (RCTs) and 40% (cohort studies). Median age was 70 years (RCTs) and 66 years (cohort studies). Median left ventricular ejection fraction was 35% (RCTs) and 40% (cohort studies). Cohort studies compared usual care with technology-assisted monitoring; RCTs compared usual care with technology-assisted monitoring and/or telephone-monitoring.

Two reviewers performed study selection.

Assessment of study quality
Two reviewers assessed methodological quality using the STROBE and CONSORT statements and graded from 0 to 10. Studies with a quality score of at least 8 were considered high quality. Disagreements were resolved by consensus.

Data extraction
Relative risks (RRs) and corresponding 95% confidence intervals (CIs) were extracted by two reviewers for the outcomes in each study. Disagreements were resolved by consensus.

Methods of synthesis
Relative risks and 95% CIs were pooled in a Mantel-Haenszel fixed-effect meta-analysis (in the absence of heterogeneity) or a DerSimonian and Laird random-effects model (where there was heterogeneity). Presence of heterogeneity was defined as I^2<20%. Cochran Q test was also used to assess heterogeneity.

Sensitivity analyses were performed for: cumulative incidence of events with usual care versus telephone monitoring and technology-assisted monitoring; cumulative incidence of events with usual care versus remote patient monitoring; duration of follow-up (≤6 and >6 months); and study quality (<8 and ≥8 on a visual analogue scale). Funnel plots were
Results of the review
Twenty RCTs (n=6,258, range 34 to 1,518) and 12 cohort studies (n=2,354, range 24 to 502) were included in the review. Two RCTs had three arms that compared usual care, telephone monitoring and technology-assisted monitoring. Ten out of 20 RCTs and 10 of 12 cohort studies had a quality score less than 8. Median follow-up duration was six months in the RCTs and 12 months in the cohort studies.

**RCTs:** Remote patient monitoring was associated with a significantly lower number of deaths (RR 0.83, 95% CI 0.73 to 0.95; 19 arms), a lower number of hospitalisations for any cause (RR 0.93, 95% CI 0.87 to 0.99; 11 arms) and a lower number of hospitalisations due to heart failure (RR 0.71, 95% CI 0.64 to 0.80; 13 arms) than usual care. Little heterogeneity was detected ($I^2<20\%$). Remote patient monitoring was associated with significantly lower numbers than usual care for combined end point of death and first hospitalisation (RR 0.86, 95% CI 0.79 to 0.94; six arms). Some heterogeneity was present ($I^2 = 28\%$). Sensitivity analyses showed similar results.

**Cohort studies:** Remote patient monitoring was associated with a significantly lower number of deaths (RR 0.53, 95% CI 0.29 to 0.96; six studies) and hospitalisations (RR 0.52, 95% CI 0.28 to 0.96; three studies) compared with usual care. High levels of heterogeneity were present ($I^2=59\%$ for number of deaths and $82\%$ for hospitalisations).

Funnel plots were presented in the online version of the report, but were not interpreted in this paper.

**Authors’ conclusions**
Remote patient monitoring confered a significant protective clinical effect in patients with chronic heart failure compared with usual care.

**CRD commentary**
The research question was supported by clear inclusion criteria. The authors made attempts to apply five popular languages in the searches, but risk of language bias could not be ruled out. Only published studies were sought, so publication bias was possible. Funnel plots were presented in the online version of the report, but were not interpreted in this paper. Study selection, validity assessment and data extraction were performed in duplicate, which reduced the possibility of reviewer error and bias. Study validity appeared to be assessed using the CONSORT statement; however, this is a reporting guide rather than a validity assessment tool and more detail regarding how this was utilised may have been useful to the reader. Few details of primary studies were available and so the extent of clinical heterogeneity could not be assessed. The appropriateness of meta-analysis could not be assessed given the lack of study details. However, there was a lack of statistical heterogeneity in the pooling of RCTs. High levels of statistical heterogeneity were present for the pooled cohort study outcomes and so these analyses may not be reliable. Publication and language biases were possible and a lack of reporting of study details made the reliability of the authors’ conclusions unclear.

**Implications of the review for practice and research**
**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that future cohort studies should assess the role of remote patient monitoring in large populations and have death and hospitalisation (any cause and heart failure) as endpoints while accounting for underlying patient characteristics. Mid-term and long-term cost-effectiveness of remote patient monitoring remained to be evaluated.

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Not stated.

**Bibliographic details**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.