Role of home blood pressure monitoring in overcoming therapeutic inertia and improving hypertension control: a systematic review and meta-analysis

Agarwal R, Bills JE, Hecht TJ, Light RP

CRD summary
The review concluded that, compared with clinic blood pressure monitoring alone, home blood pressure monitoring had potential to overcome therapeutic inertia and result in small but significant reductions in systolic and diastolic blood pressure, particularly when used with telemonitoring. The authors’ conclusions reflected the evidence, but substantial heterogeneity and potential review bias mean the reliability of the findings is uncertain.

Authors' objectives
To assess the magnitude and mechanisms of benefit of blood pressure reduction with home blood pressure monitoring compared to clinic-based blood pressure monitoring in patients with hypertension.

Searching
MEDLINE (from 1966 to May 2010), The Cochrane Library, EMBASE, Science Citation Index and ISI Proceedings were searched without language restrictions for relevant studies; search terms were reported. Reference lists of retrieved studies and relevant reviews were searched.

Study selection
Eligible studies were randomised controlled trials (RCTs) that compared home blood pressure monitoring to clinic blood pressure monitoring. Studies had to report changes in blood pressure (systolic, diastolic or mean arterial pressure) or medications used to control blood pressure or the proportion of patients who achieved a pre-established blood pressure level.

Settings in the studies included the community, dialysis units, general practices/hospitals and hospital outpatient units. The mean age of participants ranged from 47 to 77 years. Blood pressure measurements were taken either in the clinic or by ambulatory blood pressure monitoring. Blood pressure reduction was the primary goal of most of the studies.

Response rates were measured according to definitions in the included studies. Studies were undertaken in USA, Canada, Australia, Europe and Brazil. Publication dates ranged from 1975 to 2010.

The authors did not state how many reviewers selected studies for the review.

Assessment of study quality
Studies were assessed for quality using a modified Jadad score; criteria included reporting of drop-out rate, description of randomisation, appropriateness of randomisation, concealment of randomisation and whether the study was double blind.

The authors did not explicitly state how many reviewers performed quality assessment of the included studies.

Data extraction
Data were extracted on changes from baseline in blood pressure (systolic, diastolic and mean arterial pressure) and 95% confidence intervals (CIs) to calculate standardised mean differences (SMDs). Data were extracted on response rates (defined separately in each study) to monitoring and change in blood pressure medication use (decrease, increase or no change in medications combined with uncontrolled blood pressure (defined as therapeutic inertia)); risk ratios (RRs) and their 95% CIs were calculated. Data were extracted on potential explanatory variables such as age, study size, study duration, blood pressure measurement technique, specification of target blood pressure, specification of protocol for titration of antihypertensive medications, telemonitoring, chronic kidney disease and whether reduction in blood pressure was specified as a primary end point.
Two or more reviewers performed data extraction. Confirmation was provided by the lead investigator.

**Methods of synthesis**
Studies were pooled in meta-analyses. Summary effect measures of standardised mean differences in blood pressure, response rates and change in blood pressure medication use were calculated using a random-effects model. Statistical heterogeneity was assessed with $I^2$. Interaction effects were assessed for effect modification by explanatory variables. The standard error of the change was calculated, where no estimate of the variance of the difference in change from baseline in blood pressure results was provided.

Sensitivity analyses were performed by excluding low quality studies. Publication bias was assessed using the Begg test and funnel plot.

**Results of the review**
Thirty-seven RCTs (n=9,446 participants, sample size varied from 15 to 1,325 participants) were included in the review. Follow-up varied from two to 36 months. Studies varied in quality: scores ranged from 1 to 5 out of a maximum possible 5 on the modified Jadad scale.

Compared with clinic-based measurements, home-based blood pressure monitoring improved for systolic blood pressure (SMD -2.63mmHg, 95% CI -4.24 to -1.02; 22 studies), diastolic blood pressure (SMD -1.68, 95% CI -2.58 to -0.79; 22 studies) and mean arterial pressure (SMD -4.0, 95% CI -6.22 to -1.79; three studies). Substantial heterogeneity was found for the analyses of systolic and diastolic blood pressure. Heterogeneity in the systolic blood pressure analysis was explained by study size, use of telemonitoring, study limited to dialysis patients and whether a specific medication titration protocol was specified. Heterogeneity in the diastolic blood pressure analysis was explained by study size and specification of medication titration.

There was no evidence of a difference in the response rates between interventions. Response rate definitions in the individual studies varied. There was evidence of statistical heterogeneity ($I^2=69.5\%$).

Compared with clinic blood pressure monitoring, home blood pressure monitoring was associated with a greater reduction in medication use (RR 2.02, 95% CI 1.32 to 3.11; 10 studies), but there was no evidence of a difference in rates of increased medication use between groups. The analysis of reduced medication use had substantial heterogeneity, which was explained by study size and participant age.

Compared with clinic blood pressure monitoring, home blood pressure monitoring was associated with less therapeutic inertia (no change in medication) (RR 0.82, 95% CI 0.68 to 0.99; 15 studies); there was substantial heterogeneity, which was explained by age of participants (>60 years of age).

**Sensitivity analyses:** Response rates were influenced by study quality. Home blood pressure monitoring was associated with a greater response rate than clinic-based monitoring when studies with low Jadad scores were excluded (RR 1.26, 95% CI 1.10 to 1.44; five studies) and when studies with high drop-out rates were excluded (RR 1.13, 95% CI 1.04 to 1.22; 11 studies).

There was no evidence of publication bias from the Begg test and funnel plot.

**Authors’ conclusions**
Compared with clinic blood pressure monitoring alone, home blood pressure monitoring had the potential to overcome therapeutic inertia and lead to a small but significant reduction in systolic and diastolic blood pressure, particularly when used with telemonitoring.

**CRD commentary**
The review addressed a clear research question. Inclusion criteria appeared appropriate. Several relevant sources were searched for studies. No language restrictions were applied. Appropriate methods were used for data extraction. The authors did not specifically state how many reviewers performed study selection and quality assessment, so reviewer...
error and bias could not be ruled out. Appropriate criteria were used to assess studies for quality and scores ranged from 1 to 5 on the modified Jadad scale. Sensitivity analyses were used to interpret the stability of overall results through the removal of studies with lower quality scores. Appropriate methods were used to synthesise studies.

A random-effects model was used to deal with the expected heterogeneity between studies. Substantial heterogeneity was identified for most pooled analyses; this was investigated appropriately. Heterogeneity in the analyses of change in blood pressure was explored by analysing the contribution of explanatory covariates on the effect size; several potential explanatory factors were identified. There was no evidence of publication bias by the Begg test or funnel plots, but results of these investigations were not reported.

The authors’ conclusions reflected the large evidence base, but substantial heterogeneity in the analyses and potential for bias in the review process made the reliability of the magnitude of the estimated effect sizes uncertain.

Implications of the review for practice and research

**Practice:** The authors stated that home blood pressure monitoring should be accompanied by specific programmes to treat elevated blood pressure, such as titration of antihypertensive drugs through telemonitoring.

**Research:** The authors stated that larger studies were required among haemodialysis patients.

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