The effectiveness of nurse led 2-D ultrasound guided insertion of peripherally inserted central catheters in adult patients: a systematic review

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CRD summary
This review concluded that evidence from non randomised studies supported the use of 2-dimensional ultrasound guided insertion of peripherally inserted central catheters, but that a multicentre randomised controlled trial was necessary before the technology can be recommended. The cautious conclusions of the review reflect the limitations of the evidence and appear reliable.

Authors' objectives
To evaluate the effectiveness of 2-dimensional (2-D) ultrasound for the insertion of peripherally inserted central venous catheters (PICCs) by nurses in adult patients.

Searching
MEDLINE, EMBASE, CINAHL, PsycINFO, The Cochrane library, Science Citation Index Expanded, SIGLE, NHS National Research Register and Conference Papers Index were searched from inception to February 2007. Search terms were reported. No language restrictions were applied. Reference lists of identified articles and the Internet were searched and experts in the field contacted to identify additional studies.

Study selection
Studies that compared ultrasound-guided versus landmark-guided insertion of PICC in adult patients by nurses were eligible. The study population included trauma, cancer or combat patients, those with no visible or palpable veins and patients from medical and surgical units. The length of studies ranged from one to 13 months. The PICC insertion point was at or near the antecubital fossa in most studies. Nurses in some studies had received training in the use of ultrasound. The effectiveness of 2-D ultrasound on individual nurse performance was assessed in some studies; other studies assessed its effects on nursing team performance. The outcome of interest was the number of successful or failed attempts at insertion of PICC.

Two reviewers independently searched the literature and selected the articles for inclusion; disagreements were resolved by discussion or through consensus of a third reviewer.

Assessment of study quality
Two reviewers independently assessed the methodological quality of the included studies. Assessment was based on the study design, prospective/retrospective nature, sampling method, power calculation, whether baseline comparisons were made and the objectivity of the outcome assessment.

Data extraction
Two reviewers independently extracted the data from each study to derive the relative risks (RRs), and 95% confidence intervals (CI), of failed catheter insertion.

Methods of synthesis
Pooled RRs and their 95% CI were calculated using the Mantel-Haenszel fixed-effect model. Subgroup analysis was carried out based on the country in which the studies were conducted (USA and UK). A random-effects model was used if significant statistical heterogeneity was noted with the fixed-effect model.

Results of the review
Five studies (n=1,909) were included: four single centric and one multicentric. Four were before-and-after studies and one was a prospective non-randomised controlled trial. All were considered to be of poor methodological quality. There was significant clinical heterogeneity among the included studies.
Three studies showed significant reduction in failure rates with the use of ultrasound. Pooling of the data from all the five studies showed significant reduction in failure rates with the ultrasound group (RR 0.40, 95% CI: 0.33 to 0.48); there was no evidence of statistical heterogeneity.

Pooling of the data from the three USA studies showed significant benefit of using ultrasound (RR 0.39, 95% CI: 0.33 to 0.47), but with significant statistical heterogeneity. The random-effects model showed a significant benefit of ultrasound (RR 0.35, 95% CI: 0.23 to 0.54). The UK studies showed no significant benefit (RR 0.52, 95% CI: 0.26 to 1.03).

**Authors' conclusions**
Evidence from non randomised studies supported the use of nurse-led 2-D ultrasound guided insertion of PICCs. Further, more rigorous research was needed before widespread uptake of this technology could be recommended.

**CRD commentary**
The review objective was clear, as were the inclusion criteria for participants, interventions and outcomes. The search strategy was extensive, there were no language restrictions and search terms were reported. Adequate steps were taken to minimise the risk of error and bias in the processes of study selection, data extraction and validity assessment. Details of the quality assessment were well described. The reporting of details of the UK multicentre and single centre studies was not clear. The rationale behind the sensitivity analysis based on country of the study was not clear. Overall, however, the cautious conclusions of the review reflect the limitations of the evidence and appear reliable.

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

**Research:** The authors stated the need for a multicentre RCT that assessed the efficacy, complications, cost effectiveness and patient acceptability of nurse led 2-D ultrasound guided PICC insertion.

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