Central line-associated bloodstream infections in limited-resource countries: a review of the literature

Rosenthal VD

CRD summary
This review found that central line-associated bloodstream infections (CLABSIs) in limited-resource countries were higher than the US National Healthcare Safety Network benchmark rates and had a significant effect on mortality. Hand hygiene and educational programmes significantly reduced CLABSI rates. The reliability of the authors' conclusions is unclear due to possible limitations in the review process, and uncertainties about study quality.

Authors' objectives
To evaluate the efficacy of interventions to prevent central line-associated bloodstream infections (CLABSIs) in patients in the intensive care unit (ICU) and also CLABSI rates and related mortality in limited-resource countries.

Searching
MEDLINE, and the Cochrane Library were searched, for publications in English or Spanish, from January 1998 to September 2008; the search terms were reported. The bibliographies of relevant reviews were handsearched. Abstracts from conferences and meetings were excluded.

Study selection
Randomised controlled trials (RCTs), sequential studies, prospective cohort surveillance studies, or case-control studies were eligible for inclusion if they evaluated interventions to prevent CLABSIs in newborn, paediatric, or adult patients in the ICU, in limited-resource countries. Studies had to assess clinical sepsis or laboratory-confirmed bloodstream infections or both, to determine the number of CLABSIs. Eligible outcomes were the CLABSI rate and extra mortality. Eligible studies had to apply the definitions and methods of the Centers for Disease Control and Prevention (CDC) National Nosocomial Infection Surveillance System or National Healthcare Safety Network (NHSN). Limited-resource countries were those defined by the World Bank in 2007 as having lower incomes, lower-middle incomes, and upper-middle incomes. Studies were excluded if they reported the CLABSI rate per patient or the CLABSI rate per bed-day instead of per number of central-line-days. Studies were also excluded if they did not provide sufficient information to calculate CLABSI rates; or did not describe the study population.

Most of the studies were in Argentina, Brazil, Turkey, and Mexico, with one or two studies in six other countries. The majority of patients were adult or neonatal, with fewer paediatric patients; most of the adult patients were medical or surgical patients, with also coronary, neurosurgical, or cardiovascular patients; two studies were of burns patients. The information on relevant interventions was only provided for seven studies. The intervention for the one RCT was central venous catheters impregnated with chlorhexidine and silver sulphadiazine. For the included sequential prospective interventional studies, all but one, where the intervention was the use of a closed infusion system, used two to four of the following interventions: hand hygiene, catheter care, education, performance feedback, and aseptic technique.

One reviewer selected the studies.

Assessment of study quality
The methodological quality of the prospective cohort studies and case-control studies was assessed by one reviewer, using the checklists of the Scottish Intercollegiate Guidelines Network, which rate the evidence according to the type and quality of the study from the highest level (one++) to the lowest (four). Evidence of level one was provided by meta-analyses; level two by case-control or cohort studies; level three by non-analytical studies, such as case series and case reports; and level four by expert opinion. Levels one and two were subdivided according to the risk of bias or confounding in the study or studies.

Data extraction
The numbers of each outcome were extracted to calculate the rates of CLABSIs and the odds ratios of extra mortality, with 95% confidence intervals. One reviewer extracted the data.

Methods of synthesis
A narrative synthesis was provided due to the heterogeneity of the studies in particular in their patient populations, definitions of a CLABSI, and the methods used for data collection. The CLABSI rates in limited-resource countries were compared with those in CDC NHSN hospitals in the United States (Edwards, et al. 2007, see Other Publications of Related Interest).

Results of the review
Thirty relevant studies were identified (n=44,871, range 22 to 10,835). There was one RCT (n=133) and six sequential prospective interventional studies (n=3,290, range 22 to 992), but the designs of the other studies were not reported.

The CLABSI rates: These ranged from 1.6 to 60.0 cases per 1,000 central-line-days (20 studies); from 1.6 to 44.6 cases per 1,000 central-line-days in adult and paediatric ICUs (14 studies); and 2.6 to 60.0 cases per 1,000 central-line-days in neonatal ICUs (six studies). These rates were significantly higher than the mean CLABSI rates reported in CDC NHSN hospitals in the USA: 1.5 mean cases per 1,000 central-line-days in medical-surgical ICUs and 2.9 cases per 1,000 central-line-days in neonatal ICUs. Five studies found increased CLABSI rates were associated with significant increases in mortality with odds ratios ranging from 2.8 to 9.5. Of these five studies, three studies were in adult ICU patients with odds ratios for mortality ranging from 2.5 to 2.8 (specifically for the three studies: OR 2.5, 95% CI 1.1 to 5.9; OR 2.8, 95% CI 1.0 to 7.8; and OR 2.8, 95% CI 1.7 to 4.5) and two were in neonatal patients with odds ratios for mortality of 5.2 (95% CI 2.1 to 12.5) and 9.5 (95% CI 4.6 to 19.7).

The impact of the interventions on CLABSI rates (six sequential prospective intervention studies and one RCT): The interventions in all six sequential prospective intervention studies significantly reduced CLABSI rates. Five studies were in adult ICU patients. In the first, the intervention was hand hygiene, catheter care, education, and performance feedback and the CLABSI rate difference was 34.8 (95% CI 32.1 to 37.5). In the second and third, the intervention was hand hygiene, education, and performance feedback and the CLABSI rate differences were 9.0 (95% CI 28.2 to 46.2) and 26.5 (95% CI 22.4 to 30.6). In the fourth, the intervention was education, and performance feedback and the CLABSI rate difference was 5.4 (95% CI 3.3 to 7.6). In the fifth, the intervention was closed infusion system and the CLABSI rate difference was 4.2 (95% CI 3.8 to 4.6). One study was in a neonatal ICU, with an intervention including hand hygiene, catheter care, and aseptic technique, and the CLABSI rate difference was 7.6 (95% CI 6.6 to 8.6). The intervention in the RCT had no significant effect on reducing the CLABSI rates compared with controls.

Authors' conclusions
The CLABSI rates in limited resource countries were higher than the US NHSN benchmark rates and had a significant effect on mortality. The results of six sequential prospective interventional studies showed that hand hygiene and educational programmes were related to a significant reduction in CLABSI rates.

CRD commentary
This review addressed a well-defined question in terms of participants, interventions, study design, and relevant outcomes. Relevant databases were searched solely for publications in English or Spanish and abstracts from conferences and meetings were excluded, so some relevant studies might have been missed. Publication bias was not assessed. The author reported that study quality was assessed, but few details were reported and no overall conclusions were made. The quality assessment was limited as individual studies were assigned a level based on their design alone. Only one reviewer performed the study selection, quality assessment, and data extraction introducing the possibility of error and bias. The design of most of the studies was not reported and only minimal details were provided for seven studies. It was not clear which study results were significant. There was little data for the control groups, the length of follow-up, and the loss to follow-up. A narrative synthesis was provided due to the heterogeneity of the studies.

In view of potential limitations arising from the review process and uncertainties about the quality of the included studies, the extent to which the author's conclusions are reliable is unclear.
Implications of the review for practice and research

**Practice:** The author stated that it was unlikely that the implementation of hand hygiene, the use of full barrier precautions during the insertion of central venous catheters, skin cleaning with chlorhexidine, avoiding the femoral site if possible, and removing unnecessary catheters, would be sufficient to prevent CLABSIs in hospitals in limited-resource countries. For hospitals in limited-resource countries to achieve the levels of quality and patient safety found in developed countries, public nationwide and global health care policies were needed to provide health care facilities with the necessary resources and support.

**Research:** The author identified a need for further epidemiological studies to establish the effects of CLABSIs and to develop more definitive approaches for CLABSI prevention in the form of practical, low-cost, low-technology measures that could be implemented in limited-resource countries.

**Funding**
Funded by Fundacion para La Lucha contra las Infecciones Nosocomiales.

**Bibliographic details**
Rosenthal VD. Central line-associated bloodstream infections in limited-resource countries: a review of the literature. Clinical Infectious Diseases 2009; 49(12): 1899-1907

**PubMedID**
19911941

**DOI**
10.1086/648439

**Original Paper URL**
http://www.journals.uchicago.edu/doi/abs/10.1086/648439

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Bacteremia /epidemiology; Catheter-Related Infections /epidemiology; Catheterization, Central Venous /adverse effects; Cross Infection /epidemiology; Humans; Incidence; Intensive Care Units

**AccessionNumber**
1201000897

**Date bibliographic record published**
19/05/2010

**Date abstract record published**
15/12/2010

**Record Status**
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.