Education of physicians-in-training can decrease the risk of vascular catheter infection

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
An educational intervention programme consisting of an one day course on infection control practices and procedures given to physicians completing their first postgraduate year (PGY-1) and third-year medical students. The aim of the course was to improve the standardisation of infection control practices and techniques during invasive procedures such as the insertion of central venous catheters (CVCs). The study focused on the insertion of CVCs and arterial catheters because, at the study institution, physicians-in-training largely perform all of these procedures. In addition, the study examined primary bloodstream infections because more than 90% of such infections in intensive care units probably originate from CVCs. The course involved a 1-hour session on basic infection control principles taught by infection control practitioners and a hospital epidemiologist. Course content included handwashing, isolation and appropriate use of barrier garments, and handling of patients with resistant organisms and varicella. Medical students and PGY-1 physicians rotated through a series of 1-hour stations, at which they received 5 to 15 minutes of didactic instruction followed by hands-on instruction that was overseen by one to three faculty members. The PGY-1 physicians were divided into two large groups of approximately 50 persons taught on a different day as part of the orientation for new interns. The medical students were taught on a separate day. Each hands-on station had 7 to 16 participants per small group session. In the second year of the course, most of the didactic instruction that preceded the hands-on sessions was done by videotape. The courses on vascular catheters included instruction on the use of povidone-iodine for skin preparation, avoidance of antibiotic ointment at the insertion site, and use of clear plastic dressings and intravenous tubing every 3 days and not to adhere to fixed schedules for changing CVCs.

Type of intervention
Educational programme and secondary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The participants in the study were third-year medical students and physicians completing their first postgraduate year.

Setting
Hospital. The economic analysis was carried out in North Carolina, USA.

Dates to which data relate
Effectiveness and resource use data corresponded to the period between July 1995 and December 1997. The first education course was held in June 1996 and the second course was held in June 1997. The price years were 1992 and 1994.

Source of effectiveness data
The evidence for the final outcomes was based on a single study.
Link between effectiveness and cost data
Costing appears to have been conducted retrospectively on the same patient sample as that used in the effectiveness analysis.

Study sample
Power calculations were not used to determine the sample size. The infection control course was given three times in June 1996 (for 110 PGY-1 physicians and 107 medical students) and three times in June 1997 (for 95 PGY-1 physicians, 94 medical students, and 46 physician assistant students). Eight months before the first course (the baseline period) 140 physicians at all levels of training completed an anonymous survey of the perceived need for use of full-size sterile drapes. A total of 109 PGY-1 physicians who participated in the study completed the anonymous survey before the first course, immediately after the first course, and 6 months after the first course.

Study design
This was a before-and-after study carried out in a single centre with six intensive care units and one step-down unit. The duration of the follow-up was 6 months after the course. No information was given regarding the number lost to follow-up, except for 1 participating PGY-1 physician who was not surveyed.

Analysis of effectiveness
The clinical outcomes were the perceived need for full-size sterile drapes, the perceived need for small sterile towels at the insertion site, physicians' views about the use of sterile gloves, sterile gowns, masks, and povidone-iodine skin preparation, documented use of full-size sterile drapes, and the rate of primary bloodstream infection and catheter-related infection per 1000 patient-days. The number of sharp injuries that PGY-1 physicians reported to the employee health department was also recorded. When the authors compared the baseline and post-intervention periods, the seven study units were not found to differ significantly in terms of the number of admissions or severity of illness. Most PGY-1 physicians had little experience performing procedures during medical school. There was a large difference between the PGY-1 physicians who were taught in 1996 and 1997 in the percentage of those who did not perform phlebotomies in medical school (20% versus 1.1%).

Effectiveness results
The perceived need for full-size sterile drapes was 22% in the year before the course (and 33% in the PGY-1 physicians who were surveyed before the course) and 73% 6 months after the course, (p<0.001).

The perceived need for small sterile towels at the insertion site decreased from 88% to 53%, (p<0.001). However, physicians' views about the use of sterile gloves, sterile gowns, masks, and povidone-iodine skin preparation did not change significantly.

The documented use of full-size sterile drapes increased from 44% to 65%, (p<0.001).

The rate of catheter-related infection decreased from 4.51 infections per 1000 patient-days before the first course to 2.92 infections per 1000 patient-days 18 months after the first course. This represents an average decrease of 3.23 infections per 1000 patient-days, (p<0.01).

A 28% reduction in primary bloodstream infection and catheter-related infection was observed.

The number of sharp injuries that PGY-1 physicians reported to the employee health department did not differ significantly from the year before the course (15.6%) to the year after the course (19.3%).

Clinical conclusions
The study findings clearly indicate that the study educational intervention influenced physician thinking and practice.
To the authors’ knowledge, the course design, its use with physicians-in-training, and the documented improvement in patient outcomes (that is, decreased risk for vascular catheter infection) are unique and have not been reported elsewhere. The authors identified some factors which may have contributed in the success of the educational programme such as the small group format, the relative inexperience of the PGY-1 physicians (1 of 3 had never inserted a CVC during medical school) and the anxiety associated with their impending internships, which made them particularly receptive to a practical learning experience and may therefore have contributed to a "teachable moment". They also noted the success of the course in meeting the recognised personal needs of the PGY-1 physicians (reflected in them giving the course uniformly high grades) and the support from the study hospital and the involvement of fellows and faculty, all giving the course a sense of high priority.

**Measure of benefits used in the economic analysis**

No summary benefit measure was identified in the economic analysis, and only separate clinical outcomes were reported. The study was therefore a cost-consequences design.

**Direct costs**

Costs were not discounted due to the short time frame of the cost analysis. Some resource use quantities were reported separately from the costs. Cost items were reported separately. The cost analysis covered the cost of the course including supplies (mannequins and the CVC kits), each day of faculty time (physicians teaching the course and nurses involved), the full-size sterile drapes and the costs of infections. The perspective adopted in the cost analysis appears to have been that of the hospital. The costs of infections were estimated based on a conservative estimate using the CDC data and a high-end estimate using the cost data from a study published in 1994 in association with the assumption that all of the 39 primary bloodstream infections prevented were catheter-related and that 80% of the patients survived. The latter assumption was based on chart review and the data were not shown in the paper. The price years were 1992 and 1994. The cost of faculty preparation time was not included in the cost analysis. It was mentioned that additional savings may have been associated with other procedures that were taught during the course but which were not measured as part of the course evaluation.

**Indirect Costs**

Indirect costs were not included.

**Currency**

US dollars ($).

**Sensitivity analysis**

Not conducted, except for two different methods used to estimate the costs of infections.

**Estimated benefits used in the economic analysis**

Not applicable.

**Cost results**

The estimated total cost for the course was $74,081. In 1992 dollars the cost savings attributable to infections prevented were $137,163 giving a net cost saving of $63,082. The net savings with the alternative method of estimation of infection costs would be $815,309.

**Synthesis of costs and benefits**

There was no synthesis of costs and benefits because the intervention programme was the dominant strategy.
Authors' conclusions
Standardisation of infection control practices through a course is a cost-effective way to decrease related adverse outcomes. If these findings can be reproduced, this approach may serve as a model for physicians-in-training.

CRD COMMENTARY - Selection of comparators
The strategy of not using the educational programme was explicitly regarded as the comparator. This allowed the active value of the intervention programme to be evaluated. It was noted that at the time of the study the optimal strategy for minimising risk for vascular catheter infection was unclear.

Validity of estimate of measure of effectiveness
The non-randomised nature of the study design and lack of power calculations may limit the internal validity of the effectiveness estimate. It was also acknowledged that some unmeasured effects may have influenced outcomes. The study units were comparable in terms of number of admissions and severity of illness. The study sample appears to have been representative of the study population of physicians-in-training.

Validity of estimate of measure of benefit
The authors did not derive a measure of health benefit. A cost-consequences analysis was presented.

Validity of estimate of costs
Adequate details of the methods of cost estimation were given. Some resource use quantities were reported separately from the costs and the price years were specified. However, the costing was retrospective, the details of resource consumption profile were not given and it is not entirely clear whether the cost data were based on true costs or charge/reimbursement data. The effects of alternative procedures on indirect costs were not addressed, statistical analyses were not performed on resource use or cost data and the robustness of the cost results were not investigated through sensitivity analysis.

Other issues
The authors' conclusion should be interpreted in the light of the study limitations. The issue of generalisability to other settings was not addressed, although some comparisons were made with other studies. The degree to which the study sample was representative of the study population was discussed in the authors' comments.

Implications of the study
The authors believe that medical educators need to focus on developing training methods that improve patient outcomes. If other investigators can reproduce this study's findings, particularly in randomised trials, this approach may serve as a new model for ways to educate physicians-in-training.

Source of funding
None stated.

Bibliographic details

PubMedID
10766683
Indexing Status
Subject indexing assigned by NLM

MeSH
Bacteremia /prevention & control; Catheterization, Central Venous /adverse effects; Clinical Competence; Cost-Benefit Analysis; Education, Medical, Continuing /methods; Education, Medical, Graduate /methods; Equipment Contamination; Humans; Infection Control /economics /methods /standards; Needlestick Injuries /etiology

AccessionNumber
22000008146

Date bibliographic record published
31/07/2001

Date abstract record published
31/07/2001