

## Using the collaborative evidence-based practice model: a systematic review and uptake of chlorhexidine-impregnated sponge dressings on central venous access devices in a tertiary cancer care centre

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### Abstract

**Background** Greater research utilisation in cancer nursing practice is needed in Australia in order to provide well-informed and effective nursing care to people affected by cancer. This paper reports the implementation of evidence-based practice in a tertiary cancer care centre.

**Methods** Using a case report design, this paper reports on the use of the Collaborative Model for Evidence-Based Practice in an Australian tertiary cancer care centre. The clinical case describes the uptake of routine application of chlorhexidine-impregnated sponge dressings for preventing centrally inserted catheter-related bloodstream infections – a common problem in people with cancer. The processes that resulted in a service-wide practice change are described.

**Results** This model was considered a feasible method for successful research utilisation. In this case report, the chlorhexidine-impregnated sponge dressings were introduced in the tertiary cancer care centre with the aim of reducing the incidence of centrally inserted catheter-related bloodstream infections and potentially improving patient health outcomes.

**Conclusion** The collaborative model is feasible and effective for implementing clinical evidence into cancer nursing practice. The successful implementation of evidence-based practice in cancer care centres requires cancer nurses and health administrators to ensure a supportive infrastructure and environment for clinical inquiry and research utilisation.

### Background

The World Health Organization predicts that 15.5 million people will be diagnosed with cancer worldwide in 2030, compared with 11.3 million in 2007<sup>1</sup>. The growing number of people being diagnosed has a tremendous effect on the demand for cancer care services, presenting a number of challenges for cancer nurses in relation to their workload, nurse–patient ratio and the need to provide cost-effective and quality nursing care<sup>2,3</sup>. It is vital that cancer nurses continue to support and contribute to improving patient care and nursing practice, despite these challenges<sup>2,3</sup>.

Cancer nursing is a dynamic entity, which inevitably undergoes change due to technological and scientific advances, as well as an evolving nursing profession<sup>2,4</sup>. A new generation of nurse innovators, leaders and researchers is required to ensure that evidence is utilised in clinical practice to justify changes to patient care<sup>5,6</sup>. Current literature emphasises the need for all cancer nurses to deliver evidence-based nursing care, through clinical inquiry, continual research utilisation and implementation<sup>2,5</sup>. However, several barriers exist when implementing nursing research into practice, leading to insufficient research utilisation within the clinical setting<sup>2,3,5,7</sup>. Even when evidence is used, there has been a concern about the lag time from evidence generation to evidence utilisation in practice<sup>7,8</sup>.

A number of challenges prevent cancer nurses from being engaged in primary research and evidence utilisation in patient care<sup>2,3</sup>. These challenges include being too busy with clinical care to actively participate in research, having insufficient research skills, lack of interest in research, and limited time and resources<sup>2,3</sup>. At an organisational level, a lack of effective interventions to overcome the existing barriers inhibits nursing science from being used in practice<sup>5,7,9</sup>. A Cochrane systematic review conducted by Foxcroft and Cole in 2009 attempted to identify effective organisational infrastructure that supported an increase in the utilisation of research in nursing practice<sup>10</sup>. However, they found no studies that provided rigorous enough data to be recommended as an effective nursing research utilisation strategy.

A number of frameworks facilitate the process for implementing evidence-based practice in clinical decision making and care<sup>11-13</sup>. Each of these frameworks describes the steps required to utilise research in practice and consequently improve patient outcomes<sup>11-13</sup>. When practice is underpinned by evidence-based policies and procedures, patient outcomes should subsequently be improved<sup>13</sup>. However, it is unclear how these frameworks could be applied in the area of cancer nursing.

## Methods

This paper uses a case report design to describe the steps involved in implementing an evidence-based framework for clinical decision making at a service level. This paper also presents the results of a systematic review investigating the effects of routine use of chlorhexidine-impregnated sponge dressings in reducing centrally inserted catheter-related bloodstream infections. Chlorhexidine-impregnated sponge dressings are small, disk-shaped sponges saturated with chlorhexidine gluconate that is released for seven days. These dressings fit around the central venous access device (CVAD) at the entry site and are then covered with traditional, transparent, polyurethane dressings to secure them in place. This case report describes a number of processes that resulted in a service-wide practice change in an Australian tertiary cancer care centre in 2009. The systematic review presented in this paper is an original work and has not been published elsewhere.

## Clinical setting

The setting is a cancer centre of an Australian tertiary referral hospital. Each day the centre serves approximately 68 inpatients, 200 radiation therapy outpatients, 200 patients attending specialised cancer care clinics and 90 patients attending the day therapy unit. In 2009, there were more than 130,000 occasions of service within the centre. Two hundred and seventy full-time registered nurses provide nursing services in the centre to the departments of haematology, bone marrow transplant, medical oncology, radiation oncology and the haemophilia centre. Specialist nursing services in the team included 10 clinical nurse consultants, one nurse researcher and two nurse educators.

## Theoretical model

An evidence-based practice framework is one way to guide the implementation of research into nursing practice by providing appropriate steps to improve patient outcomes<sup>5,7</sup>. The collaborative model was selected to guide the current case report. The model was first described by Caramanica *et al.* as a result of the collaboration of nine hospitals and educational organisations, with the aim of enabling effective nursing research utilisation<sup>5</sup>. Specifically, the authors described the crucial steps one might take from the research appraisal phase to ultimately revising clinical pathways and changing clinical practice. This research utilisation model includes several steps such as:

- identifying the clinical problem
- clarification of the problem
- performing research appraisal
- determining alternative solutions
- examining implications for clinical practice and testing/ implementing practice change; revising current clinical pathways (based on results of trial and current research) and delivering evidence-based practice.

## Case report: A service-wide uptake of chlorhexidine-impregnated sponge dressings in an Australian tertiary cancer care centre

### Problem identification and clarification

CVADs are widely used internationally in oncology and haematology settings. Whilst they are an extremely effective method of delivering intravenous therapy, they also pose a risk of infection, especially to cancer patients who are already immuno-compromised. Catheter-related bloodstream infections can be life-threatening and very debilitating for patients, often requiring prolonged hospitalisation alongside increased costs for the health care provider<sup>14-16</sup>. Colonisation by skin flora and other organisms around the central catheter insertion site is strongly associated with an increased risk of developing catheter-related bloodstream infections<sup>17</sup>. It has been estimated that in the United States of America each infection has a mean attributable cost of US\$18,000 and a prolonged hospital stay of 12 days per episode<sup>14</sup>, emphasising the necessity of evaluating any potentially effective method of reducing the risk of developing an infection.

The nurse unit manager (NUM) at the day therapy unit of the cancer centre was responsible for purchasing equipment for the operations of the unit. At first, the NUM was approached by sales representatives with promotional materials, who claimed that current clinical evidence supported the routine use of the dressings in order to reduce infection rates. The standard CVAD dressing in use in the institution at that time were the gauze and tape dressings, applied at the time of insertion and then replaced at 24 hours with a transparent, polyurethane dressing. The polyurethane dressing was replaced every seven days, at any

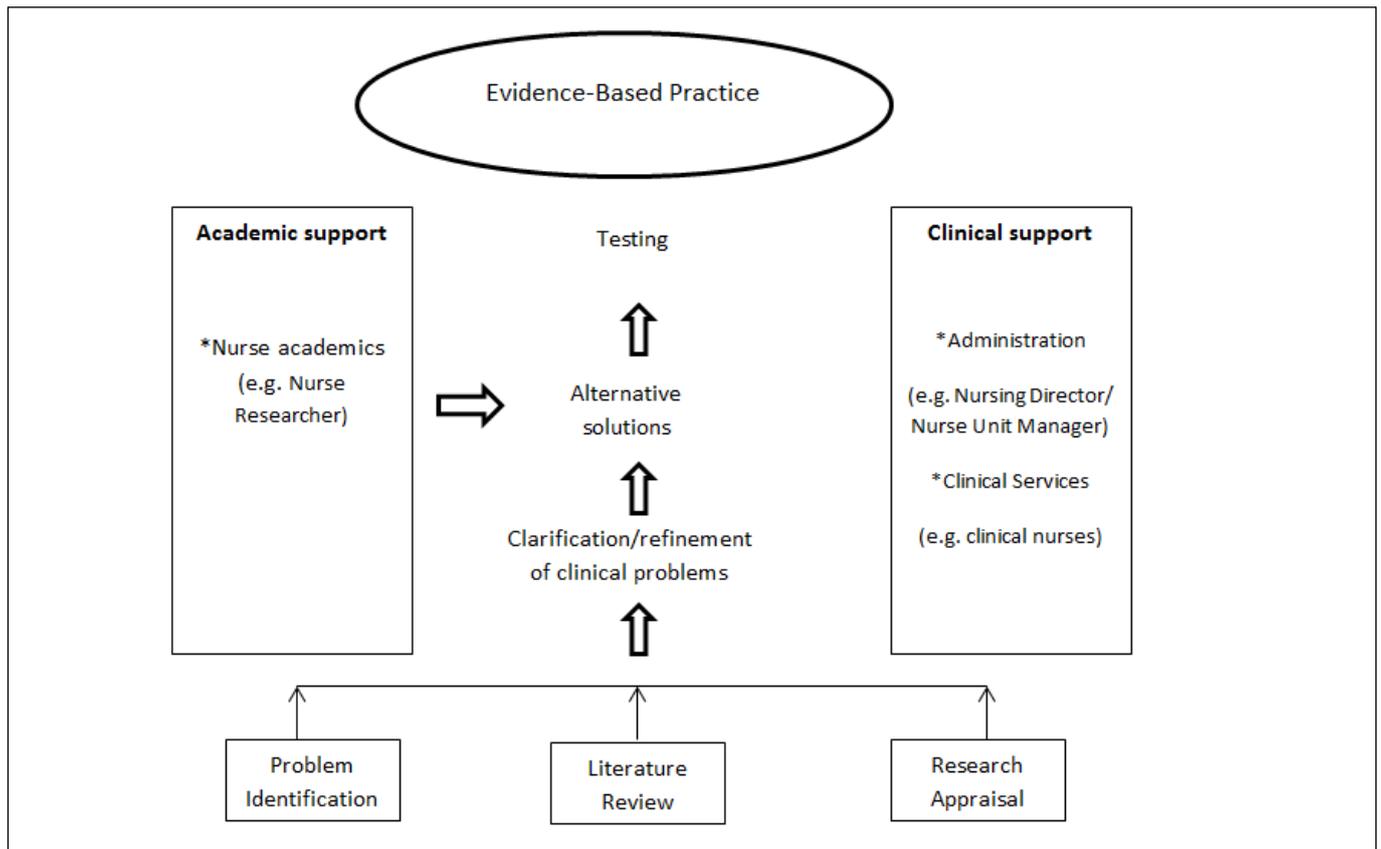


Figure 1. The Collaborative Model for Evidence-Based Practice (adapted with permission)<sup>5</sup>.

time the dressing was soiled, loose, or had visible blood pooled under it. Both dressings are recommended under various clinical practice guidelines<sup>18,19</sup>.

Whilst the NUM agreed that catheter-related blood stream infections are a valid clinical problem in cancer care, she was unsure whether the claims and data provided by the sales representatives were accurate. Thus a systematic review of the current clinical evidence on the effectiveness of chlorhexidine-impregnated sponge dressings to reduce catheter-related blood stream infections was warranted, prior to trialling this product in the unit. At this stage, the NUM and the nurse researcher proposed relevant clinical questions to resolve the identified clinical problem. The nurse researcher is co-located in the clinical environment of the cancer centre<sup>2</sup>.

The clinical questions were:

- Is the routine use of chlorhexidine-impregnated sponge dressings justified for reducing catheter-related blood stream infections in cancer patients with CVADs in our cancer centre?
- Are the dressings more effective in reducing infections than the products used in current practice guidelines for CVAD dressing changes?

The Nursing Director was informed of the initiation and the progress of the project throughout the project life.

## Research appraisal: conducting a systematic review

After the clinical problem had been identified and clarified, the nurse researcher conducted a literature search during 2009 locating a systematic review conducted by Ho *et al.* in 2005<sup>20</sup>. The use of systematic reviews has been well recognised in health care to inform clinical decisions<sup>21</sup>. The meta-analysis conducted by Ho *et al.* was published in 2006 and reported results that favoured the use of chlorhexidine-impregnated sponge dressings in a mixed population of neonates and adults with epidural catheters or centrally inserted catheters<sup>20</sup>. This systematic review searched for clinical trials up to November 2005, four years prior to the current review. Thus, an updated review, limiting the population to adult patients receiving cancer care and intensive care was needed to further validate the use of the dressings in this clinical setting. Limiting the population to adult patients in the current review was expected to provide more precise and clinically applicable data for the decision making in this instance. It was anticipated that this updated review would provide a greater precision for number-needed-to-treat analysis and be a useful clinical tool to guide and inform practice in this cancer centre.

While it was expected that this clinical case would have practice implication for all units in the cancer centre, in applying the collaborative model for practice development at the service level it was decided that the day therapy unit would be responsible for research appraisal for this clinical case. After negotiations

between the nurse researcher and the NUM, a registered nurse (RN) from the day therapy unit was released from a direct clinical service provision role for 12 days to conduct an updated systematic review with the nurse researcher. The systematic review aimed to report on the results of available evidence up to September 2009, specifically focusing on adults with CVADs. The primary objective of this review was to compare the number of catheter-related blood stream infections occurring in adult patients in whom chlorhexidine-impregnated sponge dressings were used, against the number of infections occurring in patients in whom the dressings were not used, to evaluate the effectiveness of the dressings in reducing infections and catheter colonisation.

The standard methodology of the Cochrane Collaboration was used. A search was undertaken of the Cochrane Central Register of Controlled Trials (Issue 4, 2009), Medline, EMBASE and CINAHL for relevant articles. All databases were searched during September 2009, using the following MeSH terms: antimicrobial, antimicrobial dressing, Biopatch®, Broviac®, catheter, catheterisation, dressing, central venous, central, chlorhexidine, chlorhexidine gluconate-impregnated, chlorhexidine impregnated, Hickman® line and venous. Hand searching of infection, disease and cancer journals, as well as relevant conference proceedings was performed. No language or date of publication restrictions were employed during this search. Reference lists of all retrieved articles were searched for additional studies.

The RN and the nurse researcher reviewed each paper independently. Randomised controlled trials in which the effect of chlorhexidine-impregnated sponge dressings could be compared with a control group which received no chlorhexidine-impregnated sponge dressings were considered. Participants in the included studies were adult patients (>18 years) with a CVAD and a chlorhexidine-impregnated sponge dressing. There were no restrictions placed on the diagnosis of the patient or setting (for example, inpatient, outpatient) when conducting this search. This systematic review included five randomised controlled trials involving up to 2993 patients in cancer and

critical care units<sup>22-26</sup>. This review identified an additional trial that was not included in Ho *et al.*'s 2006 review<sup>20</sup> involving an additional 3778 adult patients. All included published studies investigated the effects of Biopatch®, but not any other brand or type of chlorhexidine-based dressings. Two meta-analyses were performed using the results of the five included studies<sup>22-26</sup>. The results strongly favoured the use of chlorhexidine-impregnated sponge dressings on central catheter entry sites for reducing catheter-related blood stream infections (Odd Ratio [OR]: 0.43, 95%; Confidence Interval [CI]: 0.29, 0.64) and catheter colonisation (OR: 0.43, 95% CI: 0.36, 0.51).

The forest plots evaluated the use of the dressings versus the use of non-chlorhexidine-impregnated sponge dressings, and compared and contrasted the incidence of catheter-related blood stream infections and catheter colonisation between these two groups (shown in Figures 2 and 3 respectively). Despite the methodological differences across the included studies, heterogeneity  $I^2$  of the meta-analysis using catheter-related blood stream infections as the main outcome was 0%. Although heterogeneity  $I^2$  was higher for catheter colonisation (32%), it could be considered as being insignificant<sup>27</sup>. The insignificant heterogeneity indicated the pooling of data between these trials were appropriate. The number-needed-to-treat analysis for preventing catheter-related blood stream infections was 62; that is one episode of infection can be prevented in every 62 patients when the chlorhexidine-impregnated sponge dressings are routinely used. One episode of catheter colonisation can be prevented in every 11 patients with the use of the dressing.

### Determining alternative solutions: implications for clinical practice

The nurse researcher and the NUM discussed the findings of the systematic review and the subsequent implications for clinical practice. The meta-analysis presented in this review reported results favouring the routine use of chlorhexidine-impregnated sponge dressings on CVADs<sup>22</sup>. This review intended to examine whether chlorhexidine-impregnated sponge dressings should be routinely used in the cancer centre. In addition to considering the evidence, a cost analysis was performed. Each dressing costs

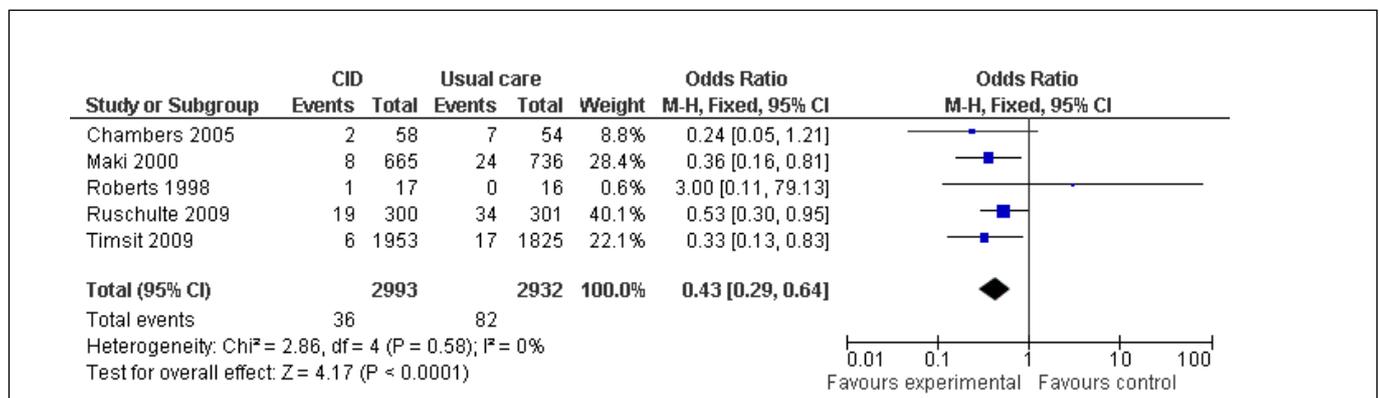


Figure 2. The forest plot comparing the use of chlorhexidine-impregnated sponge dressings versus not using chlorhexidine-impregnated sponge dressings in catheter-related bloodstream infections.

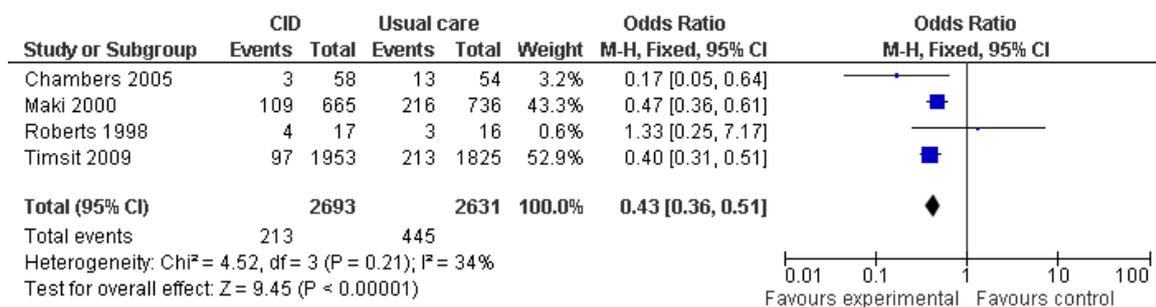


Figure 3. The forest plot comparing the use of chlorhexidine-impregnated sponge dressings versus not using chlorhexidine-impregnated sponge dressings in catheter colonisation.

A\$6.25 and should be changed 24 hours after line insertion and every seven days thereafter, as per local policy and manufacturer recommendations. According to a local database, the median length of time that CVADs were in situ in cancer patients was 29 days. If a central catheter is in situ for 29 days, it will require six dressings during this time. Therefore, the cost of preventing one episode of catheter-related blood stream infection is A\$2325. That is, A\$6.25 (dressing cost) x 6 (number of dressings required over 29 days) x 62 (number needed to treat) = A\$2325.

Although this may initially seem a significant cost, in 2007 Halton and Graves suggested that the economic implications of treating a catheter-related blood stream infection are far greater<sup>14</sup>. They described an episode of catheter-related blood stream infection leading to an increase of US\$18,000 in hospital costs and a 12-day increase in hospital length of stay, notwithstanding the increased morbidity and mortality risks to the patient<sup>14</sup>. Unfortunately, Australian data on catheter-related blood stream infection were not available for comparison at the time of the project. In addition, nursing time associated with the use of such dressings was expected to be minimal. In summary, this review concluded that chlorhexidine-impregnated sponge dressings provide a simple, cost-effective method to reduce the incidence of catheter-related blood stream infections occurring in patients within the cancer centre.

### Testing/implementing practice change

Upon completing the cost analysis, systematic review and subsequent educational meetings, the nurse researcher and the NUM of the day therapy unit presented the findings to the Nursing Director of Cancer Services, who held the ultimate fiscal responsibility over all the units within the cancer centre. The Nursing Director has since approved the use of the dressings throughout the service and it is now standard practice to apply the dressings, covered by a non-occlusive dressing, when changing CVAD dressings at this hospital. In this case report, the support of the Nursing Director was identified as a crucial factor to the successful roll-out of the practice.

Subsequently, the nurse researcher disseminated the results of the systematic review using posters and clinical education meetings. In these education meetings, the results of the cost analysis and systematic review on chlorhexidine-impregnated

sponge dressings were presented to all RNs in the cancer care centre. The manufacturer's representative was also invited to teach the nurses about the correct application of these dressings. All nurses were asked if they had any objections to the proposed change in practice. No nurses expressed objections to using the dressings for CVADs in the cancer centre.

### Discussion

The systematic review in this case report describes chlorhexidine-impregnated sponge dressings as a cost-effective and simple clinical intervention to reduce the incidence of catheter-related blood stream infections in adult patients within the cancer service. However, this case report also identified the challenges encountered by nurse administrators and clinical nurses in making evidence-based decisions. These challenges echoed the barriers as reported in the literature. Although a number of frameworks are now available to facilitate evidence-based practice, this case report demonstrated a feasible operationalisation of a collaborative model.

The collaboration between the nurse researcher, the nurse administrators and the clinical nurses was the key to the success of this clinical case. The Nursing Director's awareness of the initiation and progress of the project was important, as she was able to champion research, practice change and budgetary efficiencies. It is crucial for cancer services and health administrators to allocate sufficient resources to provide appropriate infrastructure to enable evidence generation and research utilisation at the service level. For cancer centres that have no access to a nurse researcher, formal links with university academics can be formed (for example, joint appointments/research fellows).

This case report followed the collaborative model, which described four important steps:

1. problem identification and clarification
2. literature search and research appraisal
3. determining the alternative solutions and implications for clinical practice, and
4. testing/implementing practice change.

It is also important to acknowledge that there were a number of randomised controlled trials available in the literature for meta-analysis in this case report. In cases whereby a high level of evidence does not exist, it would be prudent to await evidence for primary research prior to practice change.

The scope of this paper is limited to the report of an evidence-based practice process, but did not further evaluate the effects of the practice change in terms of clinical outcomes. However, this case report outlines the essential steps for evidence-based practice and provides the rationale and estimated analysis of cost-effectiveness to justify the practice change. It is also acknowledged that, in an ideal situation, the systematic review conducted in the evidence-based practice process should be peer-reviewed. The quality of the systematic review in this case report was upheld by adhering to the methodology of the Cochrane Collaboration for systematic review.

## Conclusion

A collaborative model for research utilisation in cancer nursing is feasible to inform the practice of cancer nurses and ensure effective patient care is delivered, subsequently improving health care outcomes. A supportive infrastructure and environment for clinical inquiry and research utilisation has been identified as necessary to enable successful implementation of evidence-based practice.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

Raymond Chan and Alison Alexander contributed to the conception and design of the study. All authors were involved in the preparation of the manuscript. All authors read and approved the final manuscript.

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