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In this issue

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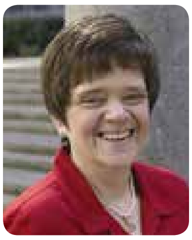

Professor Christine Miaskowski holds appointments as Sharon A. Lamb Endowed Chair in Symptom Management Research in the School of Nursing and Co-Director of Research Centre for Symptom Management at University of California, San Francisco. She is recognised internationally as an expert in pain and symptom management research and has received numerous honours and awards throughout her career in recognition of her outstanding research and service in her disciplinary areas. She is the recipient of the prestigious Oncology Nursing Society/Roche Distinguished Service Award, the highest award presented by the Oncology Nursing Society in the United States.

Christine was the inaugural nursing recipient to be awarded the Wilbert E. Fordyce Clinical Investigator Award and in 2010, the American Cancer Society Clinical Research Professorship. In 2015, she was inducted into Sigma Theta Tau International Researcher Hall of Fame. Currently, Prof Miaskowski's research team have funding worth over $50 million (US) to conduct research across a broad range of areas, including symptom management, pain management, symptom clusters, genetics, epigenetics and more. Prof Miaskowski has published close to 500 refereed publications, principally published in the top-ranking Nursing and Oncology journals.

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Editorial

The Australian Journal of Cancer Nursing: An important resource for continuing professional learning

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A professional journal such as the *Australian Journal of Cancer Nursing* (*AJCN*) plays a critical role for nurses working in cancer care. *AJCN* provides an important platform for dissemination of new knowledge about practice to enable us to deliver contemporary, evidence-based cancer services. Critical review of journal articles such as those published in this edition of *AJCN* provides an excellent opportunity to engage in ongoing learning. This process of continuing learning is integral to the provision of safe and high quality professional nursing care. Having reviewed the papers in this edition of *AJCN*, what did I learn and what will I do differently as a result of this learning?

Lane, Kiddell, Ugalde and Boltong report on a quality improvement project to explore the nature of nutrition-related enquiries received via Cancer Council Victoria's telephone support service and the role of the nurse in responding to these enquiries. The significance of nutrition within the general community and the diverse range of queries that members of the public have about nutrition-related matters in the prevention and management of cancer is an important reminder not to overlook an individual's nutritional beliefs and knowledge. After reading the paper, I reflected on the gaps in my own knowledge about nutrition-related matters, the importance of asking questions about nutritional concerns, and the need for appropriate multidisciplinary expertise, where required, to deal with nutritional matters. The article also provides some very useful tips for improving communication and assessment skills. The authors note how, in the absence of non-verbal cues, nurses used a range of skills to understand the underlying meaning of particular questions asked by callers to the help line. These skills included acknowledging emotional cues, providing reassurance, education, validation and empathy to the caller. The extracts from the calls provided within the article provide excellent examples of skilled communication that I can incorporate into my practice and my teaching of nurses.

Like nutrition, exercise is another important lifestyle behaviour that has received increased attention in recent years. The growing evidence base for the benefits of exercise means that it is something that nurses need to learn more about and incorporate into their practice. However, many nurses do not feel confident when it comes to advising patients about exercise and few treatment centres provide access to specialised exercise practitioners. Rebecca Paul provides a useful summary of the literature on the benefits of exercise for those receiving chemotherapy, types of exercises, potential barriers to exercise, information about exercise practitioners, and other considerations for nurses recommending exercise. There are some very practical tips in this paper that can easily be implemented.

Wilczek, Mangan, Barnett and White report on the outcomes of an educational intervention delivered to carers of bone marrow transplant patients. The main aim of the program was to build confidence in carers, with a particular focus on providing information about the procedure and what to expect. Importantly, the authors focused on issues such as navigating the system, communication with health professionals and the patient, and self-care. This report reminds us of the unmet needs of carers. Importantly, the paper also reminds us that patient and carer education is more than just information giving. An important lesson from this paper is that we need to ensure education focuses on building confidence and skills in aspects of the caregiving role that are fundamental to the carer's wellbeing and the wellbeing of the person they are supporting. As a researcher, I am reminded of the importance of drawing on behaviour change theories that emphasise building self-efficacy and confidence when designing educational interventions.

PICCs are in very common use in cancer care. Coyne and Jose present an integrative review of non–patient related factors that influence PICC infections in adult patients. The studies were of mixed quality and findings related to many of the factors examined also varied. Nevertheless, the authors did identify particular factors associated with catheter type, insertion technique, and maintenance as being associated with infection rates in PICC. While some factors relate to the equipment being used, many of these factors are practitioner-related. The need for education for all involved in the insertion and maintenance of PICCs is highlighted by these findings. We assume there is a large evidence base to guide practice in this area. This review highlights the need for more rigorous studies to generate evidence about the multitude of factors that influence PICC-related infections.

Cooper, Kelly and Brown undertook a survey to explore patient experience and satisfaction, including self-reported adverse events of PICC use, with a particular focus on self-reported pain, comfort and ease of managing activities of daily living. The survey identified that patients in general found PICCs facilitated their treatment experience and that few experienced significant pain. However, there were important impacts for patients in a number of activities including work, leisure and exercise. There are many nursing interventions that can be implemented to help patients deal with these restrictions on activity. Optimising function should be a key goal of nursing intervention. This means thinking beyond the hospital walls to understand the person's daily life and what can be done to accommodate or overcome the restrictions imposed by cancer treatment. PICCs might be routine for us, but not in the lives of our patients.

I was also interested to see that each paper in this edition of *AJCN* has drawn on different methodological approaches to generate new knowledge. Lane *et al.* undertook a retrospective content analysis of existing data on callers to the Cancer Council helpline. Cooper *et al.* undertook a comprehensive survey of a common patient experience in cancer settings. Wilczek *et al.* used a pre-post design to evaluate the impact of an education program, while Coyne and Jose chose to undertake a rigorous integrative review of existing evidence.

This edition of *AJCN* provides some fine examples of scholarly work that have many implications for very common areas of practice. As professionals, we engage in continual learning through many different means. Reflecting on the implications of articles in journals such as *AJCN* provides a very powerful way to engage in an active learning process so that we can continue to advance our knowledge and skills.

Evaluating the benefits of an education intervention delivered to carers of bone marrow transplant patients

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Abstract

Carer burden is common amongst carers of cancer patients due to the high level of physical, social and emotional support required. Providing tailored practical information, clarifying expectations, offering guidance on seeking help and caring for self can reduce this burden. An interactive education program was delivered which aimed to increase carer confidence in supporting bone marrow transplant (BMT) recipients. Questionnaires examined carer confidence before and after each session and a program evaluation assessed participant satisfaction. Up to 14 carers attended each session. Wilcoxon (2 related pairs) tests revealed effect sizes of −0.75 to −0.90 supporting large to very large improvements in confidence. Overall satisfaction with presentation and content was high (M=4.57, SD=.33, range=3.9–5). Carers were noticeably more confident about their BMT knowledge, and about caring for themselves, after attending the program. Qualitative feedback was positive. Constructive feedback will guide refinement and the team is exploring other media to deliver this program.

Introduction

According to the Survey of Disability, Ageing and Carers by the Australian Bureau of Statistics[1], there were 2.7 million informal carers in Australia in 2015. Among these carers, 856,000 of them were primary carers, most of whom were their family members. Meanwhile, bone marrow transplant (BMT) patients face particular issues in their treatment and recovery, hence requiring significant carers' support and imposing extra responsibilities[2]. This can put these carers at risk of physical, emotional and mental ill health.

To support these carers of BMT patients, the current study delivered a series of information sessions, providing carers with information about the BMT journey, how to navigate the hospital and health system on behalf of patients, and last, but not least, how to care for themselves along the way.

Background

Carer burden and the patient–carer dyad

Carer burden is a well-recognised problem. Carer burden or strain is the result of "competing demands, unfamiliar physical care demands and disruption of the caregiver's usual daily activities"[3]. It can include emotional, physical, mental, social or spiritual distress. As health resources become stretched, more care is being provided at home, including provision of tasks previously done by nurses[4]. With an ever-increasing ageing population, many of whom have multiple health demands, carer burden is a problem that is likely to become more widespread.

Neither the patient nor the carer exists in isolation. They are part of a patient–carer dyad where each person affects the other[5]. Northouse refers to this shared emotional system as the "concept of interdependence"[4], where a patient's distress affects the carer and vice versa. She argues that because of this interdependent relationship, "healthcare professionals need to treat the patient–caregiver dyad as the unit of care"[4]. Northouse asserts that certain nursing interventions are more effective when offered to both carers and patients and the dyad works together to manage illness-related problems[4].

Effects of caring

Emotional effects of caring include emotional distress. Australian studies documented that carers of cancer patients faced abrupt life changes after the cancer diagnosis of their loved ones[6], and this required them to take on multiple responsibilities in the physical, emotional and practical domains of their lives. For example, these carers needed to play their role in decision-making, additional household tasks, assisting with mobility, assisting with bathing and dressing, and managing medical requirements at home[6-8]. Although the values were emphasised by these participants, emotional challenges were inevitably noted.

There are also impacts on carers' physical health due to the act of caregiving. Northouse notes that sleep problems and fatigue are amongst the most commonly reported physical problems[4]. In addition, negative cardiovascular effects have been reported[9] from greater cardiovascular reactivity and increased stress levels, which have also been suggested to increase the risk of infection for carers[10,11]. An Australian study[12] also reported that carers lose opportunities for improving or maintaining their health as a result of caring for someone. Perhaps for this reason, family carers of lung cancer patients were shown to have the physical and mental health that was below population norms[13].

Nonetheless, they also noted that there were some positive aspects to caregiving. Self-esteem, relationship with the patient, and relationships with family members were the least negatively affected by caregiving; and indeed, some improvements were found with 40% of carers reporting improvements in patient and family relationships, and 20% of carers reporting improved self-esteem[13]. Studies conducted in Australia also showed similar findings by documenting that carers of cancer patients and patients in a palliative stage felt that their relationship strengthened, and also felt happy to be able to give something back to their loved ones[7,8].

Nurse interventions to assist carers

Nurses in cancer care are in a unique position to assist carers because they spend a lengthy period of time with them and their patients[5,14]. A key research area has been to develop and examine interventions delivered by health professionals to support carers and reduce their burden or distress. Psycho-educational, as the most commonly used intervention, refers to "protocols whose primary focus [is] to provide information regarding symptom management and other physical aspects of patient care as well as some attention to the emotional and psychosocial needs of patients, caregivers, and/or marital or family relationships"[15] and is the intervention of most relevance for the current study.

A systematic review of the literature by Honea *et al.*[14] did not find that any of the above-mentioned interventions achieved reduction in carer burden to the extent that they could be 'recommended for practice' as an evidence-based strategy. However, they did find that psycho-educational, psychotherapy and supportive interventions were 'likely to be effective' despite only small effects on reducing burden and distress. Whilst there were only limited studies for review in the oncology population, Honea and colleagues concluded that, "interventions without strong evidence may still be useful and can be recommended for caregivers"[14]. They also felt that certain interventions led to carers experiencing enhanced carer self-efficacy, improved self-esteem, and greater confidence in their carer role and that these effects may be valuable for other carers.

A meta-analysis of 29 randomised clinical trials by Northouse and colleagues[15] of three intervention types (predominantly psycho-educational, skills training and therapeutic counselling) across various cancer groups found that effect sizes were small to medium in terms of improvement across carer burden, coping, self-efficacy and most quality of life domains. Of relevance to the current study are the results regarding the eight studies evaluating self-efficacy as this was defined as "caregivers' perceived confidence, preparation, and/or mastery to provide care and manage patients' symptoms"[15]. Whilst effect sizes here were small, they were significant and persisted beyond six months.

In tandem with this is the way health professionals engage with carers to support their confidence and self-efficacy. An interview study of 53 cancer carers by Gilbert and colleagues[16] found that positive interactions between health professionals and carers supported carers' feelings of acceptance, comfort and ultimately empowerment, whereas negative interactions invoked feelings of distress, anger, frustration and isolation[16]. A national study by Rhodes *et al.*[17] of over 100,000 bereaved family members in the United States found that there was higher overall satisfaction with the care that their patient had received if they felt that they, themselves, had had appropriate emotional support from the hospice team prior to the patient's death as well as after their death. In terms of the current study, it is therefore essential that not only will the intervention type selected be likely to benefit carers, but also that the facilitator engages with carers in a warm, genuine, supportive and empathic way.

Caring for carers

While Northouse[5] identified several ways in which nurses can assist carers in their caregiving role, many of which have already been discussed above. They highlight the importance of making an assessment of carer capacity and providing carers with information and skills, and also emphasise the crucial role of nurses helping carers to understand the importance of caring for themselves. It is important to note that the challenges of carers of cancer patients in their self-care have been described in several Australian studies[7,8,18], with a large portion of these carers not offered emotional and psychosocial support[18].

It is this element of the caregiving experience which appears to be relatively under-researched, although other authors do propose that the content of psycho-educational programs should, and on occasion does, include information on how carers need to care for self[14,15]. Specifically, this assistance needs to entail: information about the effects of caring, referral to the carer's own primary health care specialist as required, and suggested strategies for stress management, as well as problem-solving and time management skills[5].

Aims of the current study

This study aimed to develop, deliver and evaluate an education support program for carers about caring for a family member having a BMT.

Specifically, the program aimed to:

- provide carers with an education and practical support program;
- increase knowledge, skills and confidence of carers about particular issues faced by BMT patients; and
- increase the awareness of existing community and hospital resources for patients and carers experiencing the BMT process.

Method

Participants and ethics

Carers of patients who were undergoing BMT or about to undergo BMT were invited to attend a program of education sessions. The recruitment was not limited by their care recipients' cancer or treatment types. Ethical approval was granted for the study as a low and negligible risk application. The ethical approval related to the associated surveys (pre and post) where participants could rate their level of confidence about topics explored in the education sessions, as well as the final program evaluation. Participants were not under any obligation to participate in the surveys.

The education program

A program of education sessions was designed as Microsoft Office Powerpoint presentations. The main theme of each session was: (i) Introduction to bone marrow transplant; (ii) What to expect (both patient's symptoms/treatments and navigating the health system); and (iii) Communication (with both health professionals and the patient) and Caring for self. The education sessions were developed drawing on evidence from the literature, unit-specific practice guidelines and the team's expertise.

Initially the program was conducted over a three-week period; however, after completion of the first sessions (conducted in March 2015), and based on participant feedback, the same content was presented but conducted over two weeks (June 2015). The program was conducted in the early evening and at a large cancer centre. Free information brochures from various cancer and carer organisations were provided, in addition to refreshments.

Data collection

The study was conducted by using mixed-methods by collecting quantitative questionnaires and qualitative written feedback. Evaluation methodology was firstly used to examine the impact on carer confidence. Brief pre- and post-session questionnaires to assess level of confidence were collected at each session.

Questions were specific to the content of that session. The survey contained 29 questions in total (Table 1). Likert scales from 1 to 5 assessed agreement to each question (strongly disagree to strongly agree). Whilst all surveys were anonymous, the pre-post surveys were matched (by number) so that it was possible to compare individual as well as group data relating to confidence levels.

Following completion of the program, an overall evaluation survey was also administered to examine satisfaction with the presentation and content of the program. The evaluation comprised 10 questions (Table 2) with the same Likert scale of agreement used to rate responses.

Written feedback on the content of the delivered program and its presentation was collected, in order to gain qualitative accounts of their satisfaction and experiences.

Results

Descriptive statistics

Frequency results of the pre- and post-intervention confidence questions are shown in Table 1. Confidence was higher on every individual question after the education intervention. The data was also grouped and analysed using IBM SPSS Statistics version 21. Wilcoxon (2 related pairs) tests explored changes in confidence for each session. Effect sizes ranged from −0.75 to −0.90, indicating large to very large improvements in confidence from pre- to post-education sessions.

Participants were in agreement or high agreement on every question relating to their satisfaction with the education intervention and presentation (Table 2). Overall satisfaction with presentation and content of the sessions was very high (M=4.57, SD=.33, range 3.9–5) [Wilcoxon (2 related pairs) tests].

Qualitative results

Participants were also given the opportunity to provide written feedback on the content of the delivered program and its presentation. Comments were, in the main, favourable with participants enjoying the "casual/relaxed atmosphere". Their written feedback was interpreted by using qualitative descriptive method. The qualitative descriptive method aims to provide a comprehensive summary of events and argued to be a method of choice when explicit descriptions of phenomena are required[19]. This method served the purpose of the current study as the aim was to gain a summative feedback of participants' experiences with the intervention.

Participants wrote that they would like the "presentation and structure of the content retained [as] they felt it naturally flowed. Keep the presenters and the friendly humour element". Constructive feedback was provided on areas where participants felt that the sessions could be improved. In addition to the feedback about consolidating the number of sessions, participants also wanted to have either carer case studies included, diaries of patient experiences, or have participants introduce themselves and outline their own caring situation. One participant commented that they were pleased not to have their patient attend the sessions.

In terms of navigating the ward and recognising medical and other staff, photos "of key staff, including the cleaning lady"

Table 1: Percentage of carer agreement (combined 'agree' and 'strongly agree') to confidence statements pre- and post-education intervention for both the March[1] and June[2] sessions

Education session talks	Question	PRE-combined (%) agreement	POST-combined (%) agreement
Intro to BMT[1]	I feel confident knowing who is part of my patient's health care (multidisciplinary team).	82.4 (N=18)	100.0 (N=18)
	I feel confident knowing who is the best person to contact when I have a specific question about my patient's health.	70.6 (N=18)	88.2 (N=18)
	I feel confident knowing how to contact any of the various people I may need whilst my patient is being cared for.	58.8 (N=18)	88.2 (N=18)
	I feel confident knowing how to resolve conflicting information/messages relating to my patient.	64.7 (N=18)	88.2 (N=18)
	I feel confident knowing where to find information and support for my patient.	88.2 (N=18)	100.0 (N=18)
	I feel confident knowing why my patient had to undergo the bone marrow transplant/stem cell transplant process.	94.1 (N=18)	100.0 (N=18)
	I feel confident knowing the steps involved in the discharge process at the hospital.	53.0 (N=18)	70.6 (N=18)
	I feel confident knowing what my role is as a carer throughout the BMT/stem cell transplant process when the patient is in hospital.	82.3 (N=18)	94.1 (N=18)
	I feel confident in my abilities to perform the tasks of a carer (repeated twice below).	88.2 (N=18)	100.0* (N=18)
What to expect[2]	I feel confident knowing my way around the hospital and the ward.[#]	56.3 (N=16)	68.8 (N=16)
	I feel confident knowing hygiene procedures when around BMT patients.[#]	93.8 (N=16)	100.0 (N=16)
	I feel confident knowing the methods for mouth and skin care.[#]	56.3 (N=16)	100.0 (N=16)
	I feel confident knowing the best ways to use pain medicine and overcome side effects.[#]	25.0 (N=16)	68.8 (N=16)
	I feel confident knowing some practical non-medicine ways of helping someone with pain.[#]	31.3 (N=16)	75.0 (N=16)
	I feel confident knowing the ways I can help someone who is feeling nauseated.[#]	31.3 (N=16)	81.3 (N=16)
	I feel confident knowing how to manage the health care finances for my patient.[#]	68.8 (N=16)	81.3 (N=16)
	I feel confident knowing how to access the additional information and support services at the cancer centre.[#]	68.8 (N=16)	100.0 (N=16)
	I feel confident in my abilities to perform the tasks of a carer (repeated).*	60.9 (N=23)	95.7 (N=23)
	I feel confident knowing how to identify the signs of infection.*	52.2 (N=23)	100.0 (N=23)
	I feel confident knowing how to manage infection prevention at home.*	43.4 (N=23)	95.7 (N=23)
	I feel confident knowing the existence of 'late effects' some months after the BMT.*	13.0 (N=23)	100.0 (N=23)
Caring for self[3]	I feel confident recognising the physical effects on me of caring for my patient.	50.0 (N=20)	90.0 (N=20)
	I feel confident recognising the social effects on me of caring for my patient.	45.0 (N=20)	95.0 (N=20)
	I feel confident knowing how to look after myself as I am caring for my patient.	50.0 (N=20)	95.0 (N=20)
	I feel confident to undertake activities for myself to help me cope with my role as a carer.	50.0 (N=20)	100.0 (N=20)
	I feel confident knowing how to look after my relationship with my patient whilst I am caring for them.	60 (N=20)	95.0 (N=20)
	I feel confident to seek help if I have difficulties caring for my patient.	70.0 (N=20)	100.0 (N=20)
	I feel confident knowing where to find information and support for me as a carer.	50.0 (N=20)	100.0 (N=20)
	I feel confident in my abilities to perform the tasks of a carer (repeated).	80.0 (N=20)	100.0 (N=20)

[1] In the 'Introduction to BMT' talk there were 11 participants from the March presentations and 7 from the presentation repeated in June (n=18).

[2] The 'What to expect' talk was conducted as its own talk for March but following feedback from respondents, questions were split across the June presentation so that there were only 2 talks given instead of 3.

[#] These questions from the 'What to expect' talk were included with the 'Introduction to BMT' talk in the first June session. Hence there were 9 participants from March and 7 participants from June who answered these questions (n=16).

* These questions from the 'What to expect' talk were included with the 'Caring for self' talk in the second June session. Hence there were 9 participants from March and 14 participants from June (n=23).

[3] The 'Caring for self' talk had 6 participants from March and 14 participants from June (n=20).

would be beneficial for future sessions. Flow charts and diagrams "to explain dates, treatments, cycles" were also suggested as useful aids for carers, whilst minimising jargon and acronyms was also an important reminder to the presenters to consider their audience's knowledge base.

Overall, the program was very well received, with comments such as those below highlighting the carers' needs for information, acknowledgement and support:

> *"Extremely helpful information, both the practicalities of what's ahead and the emotional issues we may encounter. Thank you to the wonderful staff members who gave their time and assistance — very much appreciated"*
>
> *"Very helpful — we were in the dark prior to this opportunity"*
>
> *"I felt quite confident in my role as a carer; however, this program has given me a far greater insight into what to expect as my role as a carer".*

Discussion

The results of this study reveal that educating and supporting carers improves their confidence. Carers were noticeably more confident after attending an education program designed to provide them with specific information about BMT patients' needs, hospital processes and the importance of caring for themselves at what is a challenging time for both their patient and themselves. The high carer satisfaction results with the presentation and content of the education program, supported by participants' written comments at the conclusion of the program, reinforce findings from other research that positive engagement with health professionals helps build confidence and self-esteem[16]. In keeping with the theory of interdependence[4] and the concept of the patient–carer dyad[5], caring for carers by improving their confidence and knowledge base is essential in terms of effectively managing BMT patients.

Table 2: Percentage of agreement (agree and strongly agree) for the course evaluation satisfaction survey.

Question	% (N=20)
The information presented was clear to me	100
The material presented made sense	100
I found that the illustrations, explanations and examples presented in this module were useful	100
The manual provided is a helpful resource	95
The information was practical for me	100
The group atmosphere encouraged participation	100
I found the content easy to understand	100
The facilitator was friendly and was interested in my needs	100
The facilitator explained the information clearly for us to understand	100
There was enough time for the amount of information presented	89.5

Every topic in the education program presented and then assessed for confidence, resulted in an improvement in confidence levels after the intervention. Interestingly, when examining the results from Table 1, the topics presented in the "What to expect" category (mostly around symptoms and symptom management), had the lowest levels of confidence before the education program. It is in these areas where 'hands-on' care is needed in the home, and where the expectation is that carers will take on these additional caring duties, which are often performed more by nurses[4]. It is clear that if there is this expectation, that more needs to be done to equip carers with the knowledge and skills to look after their patient at home. Knowledge of 'late effects' of BMT was particularly low prior to the intervention (13%) and this is quite concerning as being unprepared for 'late effects' is likely to increase carer burden or fatigue over the longer term.

It is also clear from the results that carers are not typically confident or knowledgeable about caring for themselves. The topic on "Caring for self" also showed that only around half of the carers were sufficiently confident to recognise the effects caring had on them and what they may do about it. They were slightly more confident about how to look after their relationship with their loved one and even slightly more confident again about knowing where to go to get help for their loved one. But in the first instance of directly looking after themselves, half the carers were not sure what to do. These results therefore support the need for carers' programs such as this. Carers do not necessarily willingly find themselves in the caring role and it does require some adjustment[3]. Education and the facilitation of information by engaged health care professionals and treatment centres are important early steps in not only caring for carers, but also in the overall management of BMT patients.

Limitations

The main purpose of delivering these information sessions was to support the carers of BMT patients at the study site. It was considered that collecting extensive demographic information of the carer participants and their loved ones receiving BMT may deter them from participating in these sessions. Consequently, the current study carries a limitation of lacking generalisability by not providing detailed demographic information such as types of BMT, types of cancer, age and gender. However, the current study provides preliminary evidence to suggest that carers of BMT patients can benefit from having such support services, hence contributing to the body of knowledge.

Implications for practice

Constructive feedback on program content and delivery, detailed in the comments provided by participants, will guide further refinement. The team is exploring other media to deliver this program, particularly to support rural, regional and remote areas. This is an important program which should be routinely delivered to carers of BMT patients and extension into other areas should be investigated.

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Exploring the patient experience of living with a peripherally inserted central catheter (PICC): A pilot study

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Abstract

Background: Peripherally inserted central catheters (PICCs) are used to administer chemotherapy to oncology patients. A review of the literature revealed a gap in the understanding of the patient experience of living with a PICC.

Aim: To explore patient experience and satisfaction including self-reported adverse events of PICC use.

Methods: A prospective survey was utilised to gain an understanding of patients' experiences of living with PICCs. The survey included self-reported pain, comfort and ease of managing activities of daily living. Participants were surveyed at two time points over one month.

Results: The positive aspects of PICCs included ease of treatment and little pain being associated with the PICC site. However, PICCs did hinder patients in a number of activities including work, leisure and exercise.

Discussion: Little research has been conducted exploring patient experience of living with a PICC. This small pilot study identifies areas that warrant further investigation to assist with providing patient centred holistic care.

Introduction

Peripherally inserted central catheters (PICCs) are widely used at the study hospital for patients who are undergoing anti-cancer treatment and require a central venous access device (CVAD), either for a clinical indication or individual choice. From June 2015 to July 2016, 175 PICCs were placed in oncology patients at the study hospital. A small pilot study was conducted during February and March 2016, to explore the experiences of oncology patients receiving chemotherapy treatment with the PICCs currently in use at the hospital.

Background

CVADS are used in the administration of intravenous medications, including chemotherapy. A PICC is a type of CVAD that enables administration of intravenous therapy. Without such a device there may be delays in therapy and a consequent extension of hospital stay. PICCs have become the CVAD of choice for patients receiving intravenous therapies for longer than five days[1-3]. It is becoming more common for patients to need lines in place for a prolonged length of time due to the duration of treatment and the infusion of vesicants[4]. The placement of PICCs can have an effect on patient's activities of daily living[5] and the presence of a CVAD can also cause psychological distress[6].

There have been a number of trials comparing different types of PICCs and monitoring for adverse events but these all lack one major element: measurement of patient satisfaction[7-11]. Nagel *et al.*[2] explored patient satisfaction through surveying patients with totally implantable venous ports. Overall, the results showed positive feedback, but it was found patients had issues with cosmetic aspects of the port, including the visibility of the scar and the port capsule. A PICC is visible and often raises questions about body image and the effect on the patient's activities of daily living[12]. Alpenberg[13] and colleagues recognised that a study to assess the patient experience would be useful to identify the challenges that can affect those with PICCs, including showering, bathing, hair washing and sleeping. Considering the patient experience is a core element in ensuring patient-centred care is delivered[14]. The patient's experience with a PICC extends beyond initial insertion and the administration of medication, becoming part of their everyday lives. The experience of living with a PICC has had little exploration in the literature and gaining knowledge on this could further promote patient-centred care in this group of patients.

Study design and methodology

Method

A pilot study which consisted of a prospective survey to gain an understanding of the experiences and satisfaction of patients who had new PICCs inserted at the study hospital was conducted. The survey employed a mixed methodology, collecting both quantitative and qualitative data (open-ended questions). The survey utilised for this study was an adapted version of a previously designed survey which examined patient experience with totally implantable venous port systems[2]. Permission to use and adapt the survey from the Nagel *et al.*[2] study was obtained from the primary author. With author consent, the survey was adapted to fit our target population of oncology patients with PICCs. The questions were adapted to ask about PICCs rather than ports and the phrasing of some questions was slightly altered to suit English-speaking Australian participants because the original survey was written for German participants. Questions from the original survey regarding height, weight and degree qualification were removed as this data was not relevant to the study. Data regarding the date and reason for insertion was omitted from the survey as this information was already known and did not need to be obtained from the participants. An option for participants to elaborate in words on how the PICC affected their activities of daily living and leisure time was added to the survey. A question relating to the cost of the PICC insertion was also added to the survey as the study was conducted at a private hospital and the out-of-pocket costs for patients can range from $40 to $800.

This survey assessed pain, comfort and ease of managing activities of daily living. Any adverse events such as infection or blockage of the PICC which were reported during the period of the survey were monitored and included in the results. Potential participants were invited to participate in the study over a one-month period and were requested to complete two surveys, the first at one week post PICC insertion and the second at four weeks post PICC insertion. A fixed sample size was not required for this pilot study following consultation with a biostatistician. Potential participants were recruited over a one-month period.

Before administering the survey to participants, we ensured there was content and face validity. Each question was analysed by a panel of experts, to give their opinion about whether the question is essential, useful or irrelevant to measuring the construct under study[15]. The expert panel for this study included the oncology nurse practitioner, the hospital nursing and midwifery research team, the oncology staff development nurse, the oncology nurse manager and an oncology clinical nurse. Additionally, panel members were asked to assess the face validity of the survey which required a personal judgement, of whether they thought the test was well constructed and useful[16]. The survey was then further assessed by a small group of current oncology patients with PICCs who were asked to assess the survey in terms of content and user-friendliness. Consultation with the panel of experts resulted in the inclusion of a question about the cost of PICC insertion and adding open-ended questions about activities of daily living and leisure time. The review of the survey by current oncology patients found it was user-friendly and understandable from their perspective. No changes were suggested by the group. These patients were not included in the final study to eliminate the likelihood of expectancy, reactivity or awareness[17].

Sample and inclusion criteria

Any patient aged 18 years and over, who was an oncology or haematology patient and had a PICC inserted at the study hospital for the purposes of chemotherapy treatment was eligible to participate in the study. Patients under 18 years of age, patients with PICCs but who were not oncology patients, oncology patients with a PICC not receiving chemotherapy treatment, patients with a PICC inserted outside of the study hospital, patients with other types of CVADs or who were non–English speaking, were excluded from the study.

Ethical concerns

An application to undertake this study was submitted to the St John of God Healthcare Research Ethics Committee (No: 932) and Curtin University Human Research Ethics Committee (HR18/2016). Potential participants were fully informed about the research via a participant information letter and consent was inferred through the completion and return of the surveys. As the study was low risk, written consent was not required and inferred consent was approved by the Human Research Ethics Committees.

Results

During the four-week recruitment period a total of 40 PICCs were inserted in the radiology department, 10 were in oncology patients and of those only six had their PICCs inserted for the purpose of chemotherapy treatment. All six of the eligible patients agreed to participate in the study. The six participants were recruited between February and March 2016. There was

Table 1: Participant responses

	Very n=	Quite	Somewhat	A little	Not at all	Did not answer	Total
Overall, how satisfied are you with the PICC system?							
Week one	1	5	0	0	0	0	6
Week four	4	1	0	0	0	0	5
In a similar situation, would you choose the PICC again?							
Week one	1	4	1	0	0	0	6
Week four	3	1	0	0	0	1	5
Are you afraid of complications with the PICC?							
Week one	0	0	0	3	3	0	6
Week four	0	0	0	1	4	0	5
Do you often think about the PICC?							
Week one	0	1	0	4	1	0	6
Week four	0	0	1	2	2	0	5
Do you consider the PICC as a disturbing foreign body?							
Week one	0	0	0	5	0	1	6
Week four	0	0	2	0	3	0	5
Are you concerned about the appearance of the PICC?							
Week one	1	0	0	1	4	0	6
Week four	0	0	0	3	2	0	5
Were you sufficiently informed about the PICC insertion procedure?							
Week one	0	3	2	0	1	0	6
Was the insertion painful?							
Week one	0	0	1	1	3	1	6
Does the PICC cause pain?							
Week one	0	0	0	1	4	1	6
Week four	0	0	0	0	5	0	5
Are you afraid of having your PICC accessed?							
Week one	0	0	1	2	3	0	6
Week four	0	0	0	1	4	0	5
Do you think the PICC has simplified your treatment?							
Week one	2	2	2	0	0	0	6
Week four	3	2	0	0	0	0	5
Does the PICC obstruct your daily activities?							
Week one	0	0	1	3	2	0	6
Week four	0	0	0	2	2	1	5
Can you enjoy your leisure time with the PICC?							
Week one	1	4	1	0	0	0	6
Week four	1	2	2	0	0	0	5
Did the cost of having a PICC inserted cause concern?							
Week one	0	0	0	1	5	0	6
Week four	0	0	0	1	4	0	5

an equal representation of gender and the age of participants ranged from 49 to 72 years. One participant only completed the week one post insertion survey because the PICC was removed prior to the week four survey as it was no longer clinically indicated.

Only one participant reported being given options for the type of device being placed. There was a single participant-reported adverse event at week one and none at week four. The self-reported complication was water from the shower infiltrating the PICC dressing. No complications occurred that required a PICC to be removed or replaced. Of the six participants, two were actively in work at week one. Both felt significantly hindered at work by their PICC. At the time of the week four survey, one of the participants in work felt quite hindered and the other a little hindered by their PICC. Five of the six participants reported that they exercised at week one post insertion. Only one participant felt not at all hindered by the PICC during sports or exercise. At week four post insertion, four of the five participants reported that they exercised and again only one felt that the PICC was not a hindrance. Table 1 outlines the results for the other questions in the survey.

Discussion

It was concerning that only one participant had a choice about the type of device inserted for chemotherapy treatment. The participant who was given a choice had the discussion about device types and options with a clinical nurse consultant after a previous port failure. It was positive that there were no complications requiring removal of the PICC. The one self-reported complication from a participant at week one was shower water entering the PICC dressing, which would not be considered as a complication from a clinical perspective.

Participant overall satisfaction with PICCs increased from week one to week four post insertion and there was also an increase in the numbers of those who would choose to have a PICC inserted again. This would suggest that as time elapsed participants adapted and became more used to having a PICC in situ and also got to appreciate the benefits in terms of ease of treatment via the PICC. This is further supported by the fact that participants were less afraid of having their PICC accessed at week four compared to week one. Appearance of the PICC was not a concern for the majority of the participants but one participant did feel very concerned at week one post insertion:

> *"It is quite ugly and needs clothing to cover which in hot weather is difficult"* (Participant 02).

This concern over the appearance of the PICC was similarly found in a study by Nagel *et al.*[2] assessing patient satisfaction with totally implantable venous ports. It is likely that in a larger sample, patients would express concerns over appearance which may also be affected by the season, the type of clothes the person prefers to wear and other factors.

In our sample, pain did not seem to be a significant issue either at initial insertion of the PICC or in day-to-day life with the PICC in situ. By week four all participants reported no pain from the PICC, indicating that any pain associated with the PICC was short-lived. Although the PICCs did not cause significant issues with pain there was evidence that PICCs did affect work, leisure time and exercise for participants. Of the two participants who did work, both indicated that the PICC hindered them at work. This lessened from week one to week four but still presented problems for them. This suggests that working with a PICC could present challenges to patients still engaged in employment and future research could further explore this aspect of living with a PICC. The survey did not collect data on the type of work participants engaged in or exactly how the PICC affected work for participants. Including this in future studies would provide more insight.

Only one participant felt they were able to fully enjoy their leisure time. This, like work, is an area which warrants further investigation in future research. The majority of participants exercised, with only one reporting that they did not exercise at all. The participant indicated in their response as to why they did not exercise:

> *"Chemo does not allow much exercise"* (Participant 01).

Chemotherapy is not a contraindication to exercise[18] so it would seem this participant could have had a lack of understanding in this area or perhaps other factors, for example lack of time or symptoms from chemotherapy such as nausea, vomiting or fatigue prevented the participant from exercising. Future research to explore patients' beliefs about exercise and chemotherapy could provide better understanding as to why some patients engage in exercise during treatment whilst others do not. Of the participants that did engage in exercise, only one participant felt that the PICC did not hinder them at all during exercise. Data on the type of exercise engaged in was not collected for this pilot study but would be useful to obtain in future studies.

Overall, the adapted survey employed provided a useful insight into participants' experience and satisfaction of day-to-day life with PICCs. Obtaining more data on the types of work and exercise participants engaged in and exactly how the PICC impacts on these activities would be key for future surveys. The survey could also be strengthened by being used alongside a validated scale to measure quality of life such as the SF-12 Health

Survey[19]. By combining the survey with such a scale the effect of the PICC on quality of life could also be assessed, which would provide a more complete picture of the psychological, social and sexual wellbeing of participants.

Limitations and recommendations

This small pilot study highlighted a number of areas (work, leisure time and exercise) for patients with PICCs, which should be further explored in greater detail with a larger sample size. Information on exactly how the PICC can hinder patients in these activities and how participants adapt to manage the challenges faced would be key to obtaining a fuller picture of the patient experience and satisfaction with PICCs.

Conclusion

This pilot is one of the few studies which has begun to explore the experiences of patients living with a CVAD beyond initial insertion. In terms of pain, ease of treatment and appearance PICCs were a good option for the small number of participants enrolled in this pilot study. Participants seemed to adapt and find the completion of activities of daily living easier as they had more time with the PICC in situ. However, PICCs do seem to continue to hinder patients with exercise, leisure and work activities. Gaining a better understanding of patients' experiences living with a PICC will assist in providing more holistic care and better informing and preparing patients for whom a PICC is necessary for chemotherapy administration.

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Exercise promotion during chemotherapy treatment: recommendations for the Australian oncology nurse

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Abstract

Exercise has proven physiological and psychological benefits when undertaken regularly and with appropriate guidance. The understanding of exercise and its effect on adults with a diagnosis of cancer can be misunderstood and is still evolving. Oncology nurses are in frequent contact with people receiving chemotherapy for cancer, placing them in an ideal position to educate and empower patients to begin or maintain regular exercise. This paper identifies the benefits of exercise in adults with a diagnosis of cancer receiving chemotherapy, types of exercises to recommend to patients, potential barriers to patient compliance, information about exercise practitioners, and considerations and contraindications. The potential for improved health outcomes through exercise intervention is undeniable. Oncology nurses are vital for increasing awareness and providing practical advice to patients undergoing chemotherapy treatment.

Introduction

It is widely acknowledged that regular exercise is the foundation of a healthy lifestyle. Its role in improving cardiovascular, musculoskeletal, metabolic and psychological health is firmly established in the general population[1]. It also has proven benefits for adults undergoing chemotherapy treatment for cancer[2]. Regular exercise can alleviate common side effects of said treatment such as fatigue and depression, which can prove debilitating[2,3]. It may also have an indirect effect on enhancing tumour-suppressing processes[4].

Particularly for nurses, it is important to be able to differentiate between the types of exercise and the benefits they offer. Forms of exercise include aerobic, resistance and flexibility-based activities. As with other clinical knowledge, not having a thorough understanding may result in fruitless attempts at educating patients and families[5]. Information about the importance of exercise is often omitted from patient education[6]. An oncology nurse's role is vital in identifying patients who may benefit from regular exercise intervention, particularly people undergoing chemotherapy treatment. There is a unique opportunity to provide education and promote accountability during the chemotherapy treatment phase. This paper is intended as a resource for oncology nurses involved in chemotherapy administration to guide discussions with their patients.

Cancer type, treatment and associated side effects

Treatment of solid tumour cancers can be multidimensional and encompass surgery, radiation, chemotherapy and hormonal or targeted therapies. Treatment of haematological malignancies is similar and may include radiation, stem cell transplantation, chemotherapies and hormonal or targeted therapies. Potential complications of treatment, specifically chemotherapy, include deterioration in physiological or psychological function, infection, diarrhoea, constipation, anaemia, thrombocytopenia, neutropenia, nausea, vomiting, pain, neuropathy and fatigue[2]. Side effects may occur in a cyclical pattern; at times worse, potentially during an active treatment phase where patients have recently received chemotherapy. Furthermore, symptoms may persist for months or even years following treatment[2].

Side effects can also be specific to the type of therapy being used. Anti-cancer drugs, such as anthracyclines, taxanes, alkylating agents, humanised monoclonal antibodies and antimetabolites, carry a high risk of cardiac dysfunction[7]. Taxanes, platinum-based compounds, vinka alkaloids, immune modifiers and proteasome inhibitors are associated with a higher incidence of peripheral neuropathy[8]. These complications may be reversible or non-reversible and present as an acute episode or persist long-term[7,8].

While the ultimate decision is made by the medical oncologist, chemotherapy nurses are in a position to identify patients who may be suitable for exercise interventions based on their individual circumstances[9]. Rudimentary factors to consider include:

- type of chemotherapy and the level of emetogenicity and myelosuppression
- presence of a central venous access device (CVAD) or chemotherapy pump
- location of disease and affected organs
- other comorbidities
- level of previous exercise participation[9,10].

Nurses involved in exercise promotion should understand the nature of the malignancy and its specific treatment modality, and clarify any uncertainties with medical or exercise professionals[9].

Why exercise?

Seminal work published in 1989 found 10 weeks of routine aerobic exercise in women undergoing adjuvant treatment for breast cancer improved patients' functional ability and reduced chemotherapy-induced nausea[11]. This initiated a change in attitude about the perceived detrimental effect of exercise during chemotherapy treatment and paved the way for further examination. Ensuing research undertaken in recent years has shown that regular exercise can mitigate fatigue and depression and improve body strength and quality of life in patients receiving chemotherapy[12-14]. Outcomes observed from a randomised controlled trial showed improved haemoglobin levels, white blood cell counts, sleep quality, quality of life and reduced fatigue following a 21-day exercise program in patients undergoing chemotherapy for non-Hodgkin lymphoma[15]. Ten patients receiving induction chemotherapy for acute leukaemia exhibited improvements in cardiovascular endurance, fatigue and depressive symptoms following an exercise intervention integrating aerobic and strength activities[16]. A Cochrane review of 36 randomised trials demonstrated an improvement in social and physical function in adults performing regular exercise while undergoing active cancer treatment[10]. Similarly, in cancer survivors, regular exercise has been shown to contribute to improve quality of life by enhancing self-efficacy and self-esteem[17].

Regular physical activity during treatment has also been associated with increased survival rates in some cancers[4,14]. Previous research has shown an indirect association between exercise and the stimulation of an anti-tumour response within macrophages[4]. However, more research is needed to elucidate this. Mouse models have also established that exercise reduces the incidence and growth of tumours through various cell mechanisms[18]. Study outcomes like these give weight to the theory that regular exercise may enhance a protective immune response against cancer cells[4,18].

In Australia, being physically active almost every day of the week is recommended to reduce the risk, and assist in the recovery, of certain cancers[19]. Physiological and psychological benefits have been observed when exercise is undertaken throughout the cancer treatment trajectory, not just isolated to the recovery phase[14]. A position statement from the Exercise and Sports Science Association maintains that a lack of exercise during this phase can lead to a worsening of side effects and functioning and, consequently, a poorer quality of life[2].

Recommending exercise to patients

Distinguishing between different types of exercise is an initial step in being able to recommend exercise to patients. Aerobic, resistance and flexibility type exercises should be recommended to provide a well-rounded routine.

Aerobic activity improves cardiovascular and respiratory function[1], which may enhance patients' ability to tolerate full doses of chemotherapy without requiring dose reductions or prolonged breaks between cycles. It is also associated with improved sleep, mood, energy levels and body size[20]. For adults receiving chemotherapy, these outcomes may contribute to their overall ability to cope with treatment. Activities that increase the heart and respiratory rates, such as walking, cycling, swimming or team sports, are considered aerobic.

Resistance-based exercises strengthen and build lean muscle, which can improve posture and help to relieve joint or bone pain. Muscle atrophy, typical of cachexia, can also lead to an increased risk of bone fractures. Weight training contributes to improving or maintaining bone density, which is particularly important for people who are at risk of osteoporosis due to certain chemotherapy regimes[21]. Resistance exercises include lifting, lowering, pushing or pulling movements using the patient's body weight, free weights or machine weights[2].

Flexibility exercises lengthen muscles and tendons, improving muscle tone and joint movement[9,14]. Chemotherapy can accelerate the natural ageing process, making muscles and joints less mobile[9]. Stretching can also provide a time for patients to relax and reflect on events. Flexibility exercises include dynamic or static stretching.

A Cochrane review of 56 trials found that moderate to high-intensity exercise provided more benefit to people undergoing cancer treatment than low-intensity exercise. Participants were found to experience improved health-related quality of life, functional capacity, sleep quality, anxiety levels and fatigue[22]. For people undergoing chemotherapy and without contraindications to vigorous activity, this review infers greater benefit from high-intensity exercise[11,22].

Patients should participate in exercise they enjoy and can perform at their own pace while maintaining consistency over time[2]. Progression through the exercise program should be individualised and flexible to optimise personal gain while maximising enjoyment[2,13]. Oncology nurses ought to encourage patients to participate in exercise; however, should refer to an exercise professional for personalised exercise prescriptions. Individuals lacking enthusiasm could be encouraged to use game consoles such as the Nintendo Wii which have been shown to improve motivation, provide distraction and reduce time awareness[3]. Furthermore, nurses can use the initiation period of the cancer treatment journey as a window of opportunity to establish and sustain a new, healthier way of life in patients who were previously sedentary[23]. Patients who already participate in regular exercise before commencing treatment may focus on maintaining this or returning to that level once they are ready[9].

Referring to exercise professionals

There is consensus that more specific, individualised exercise prescription should be provided by highly trained and well-informed exercise practitioners[2,20]. In Australia, such practitioners are members of the Exercise and Sports Science Association of Australia and have achieved accreditation as either an exercise physiologist or exercise scientist[24]. The role of an exercise professional working in the oncology setting is to support people with a cancer diagnosis to maintain or initiate regular physical activity[24]. Some cancer treatment facilities employ said practitioners so patients have direct access to them throughout their treatment. Alternatively, physiotherapists and occupational therapists can provide services that recognise physical limitations to optimise patients' quality of life and functional status[25]. Oncology nurses who do not have a direct referral system to exercise professionals can use the Exercise and Sports Science Australia website to perform a search for accredited exercise professionals specialising in the cancer population[24]. Nurses who are confident in providing exercise advice, or are treating a patient who does not wish to see an exercise professional, should refer to national guidelines published by the American College of Sports Medicine[20] and Sports Science Australia[2] for additional guidance.

Barriers to exercise intervention

When discussing exercise, nurses should consider potential barriers that may affect their patient's ability or willingness to participate. These may include social norms, current level of exercise, physical impairments or restrictions, cultural beliefs, personal beliefs, lack of awareness, age, gender, availability of safe exercise areas, geographical location or climate, access to transportation, or income[1,6]. Strategies to overcome these factors are outlined in Table 2.

Contraindications and considerations for exercise recommendation

Special patient populations such as those receiving chemotherapy require exercise advice that has been developed with specific considerations in mind[2,20]. For absolute contraindications to certain types of exercise see Table 3.

Table 1: General exercise recommendations for patients receiving chemotherapy

	Aerobic	Resistance	Flexibility
Activities	Walking, cycling, running, aerobics, boxing, dancing, gardening, golf, team sports, swimming, etc.	Body weight push-ups or squats, free weight lifting, lowering, pushing or pulling movements, weight machines, resistance bands.	Dynamic or static stretching exercises for all muscle groups
Frequency	3–5 times, or 2.5 hours, per week.	1–3 times per week with rest days in between.	3–4 times per week
Intensity	20–30 minutes of continuous moderate–vigorous (depending on fitness level and treatment regimen) exercise, or 3–5 minute bouts with rest.	50–80% of one-repetition maximum, or 6–12 repetition maximum. 6–10 exercises with 1–4 sets per exercise. 60–90 second rest between sets.	Hold each stretch for 15–30 seconds. 1–4 sets for each side. 6–10 different stretches.
Progression	Increase gradually once frequency and duration are being met. Progression may be slower for deconditioned patients.	Increase gradually once frequency and duration are being met. Progression may be slower for deconditioned patients.	Increase gradually once frequency and duration are being met. Progression may be slower for deconditioned patients.

Adapted from references 2 and 9

Table 2: Potential barriers to exercise and associated resolution strategies

Barrier	Resolution strategies
Social norms, cultural and personal beliefs	Explore patient's concerns Provide education on importance of exercise Refer to appropriate allied health professionals such as pastoral care, social work Refer to support groups, where appropriate
Lack of awareness of benefits of exercise	Explore patient's current knowledge on exercise benefits Provide education based on current research
Age/gender	Reassure patient that exercise is safe for all ages and genders Adjust discussion based on global recommendations for appropriate age category[1]
Availability of safe exercise areas, location, climate, income	Explore patient's concerns regarding safety, location, climate or travel Refer to allied health, legal, financial or volunteer services, where appropriate
Physical limitations, restrictions or sedentary lifestyle	Assess patient's physical restrictions, level of mobility or current level of exercise Refer to occupational therapist, physiotherapist, exercise physiologist or medical team, where appropriate

Adapted from references 1 and 9

Table 3: Contraindications based on exercise type

Type of exercise	Absolute contraindication
Swimming	Neutropenia Haemoglobin <80g/L Urinary catheterisation Skin irritation External central venous access devices Wound recovery
Shared gym areas	Neutropenia
High impact activities/ contact sports	Bone primary or metastases Haemoglobin <80g/L Thrombocytopenia Treatment-related bone pain
Free weights (without a partner)	Peripheral neuropathy Haemoglobin < 80g/L Ataxia Vertigo
Balance/coordination-based activities (cycling, treadmill) without partner	Peripheral neuropathy Haemoglobin < 80g/L Vertigo

Adapted from references 2 and 9

Recurrent nausea during chemotherapy treatment can be highly distressing and have a negative impact on patients' quality of life[26]. Attempts to exercise while experiencing nausea may be futile. Furthermore, protracted vomiting contributes to dehydration, which may lead to renal or cardiovascular complications[26]. Nurses should assess their patients' levels of nausea by asking appropriate questions about their ability to perform daily activities. Determining when their nausea is at its worst, or where there is a pattern, can assist the nurse in seeking an appropriate antiemetic regimen from the medical team. Consideration of the emetogenicity of the chemotherapy drugs, monitoring of acute and delayed nausea and vomiting, and recognition of anticipatory nausea will also assist[26].

Metastatic disease with skeletal involvement is traditionally viewed as a contraindication for exercise as it carries a risk of fracture or injury. Initial research with a small population established that people with bone metastases tolerated regular resistance exercises well[21]. The authors acknowledged the improvement in levels of physical activity and lean muscle mass and recommended further research be undertaken with a larger sample population[21]. Consequently, oncology nurses should have a sound knowledge of their patients' diagnoses before recommending exercise in this patient group, particularly activities which are high impact or carry a risk of falling. For patients in this risk group, it is recommended they adhere to a specifically designed program that is directly supervised by an exercise professional.

Lymphoedema is a recognised side effect of certain cancer treatments that may occur prior to, during, or after chemotherapy. At least 20% of people with breast, gynaecological and prostate cancer and melanoma will experience lymphoedema as a result of surgery or radiotherapy[27]. There is a common misconception that patients with lymphoedema should avoid the strenuous and repetitive movements that are involved in weight training[28]. However, various studies have indicated these types of activities can be safely performed by all affected limbs without worsening the incidence of lymphoedema[20,28-31]. Regardless, an individual regimen should be developed that accounts for areas of the body affected by cancer[28,30].

Cardiac or neurological effects from previous anti-cancer drug therapy can inhibit a patient's ability to perform regular exercise and the intensity to which it can be undertaken[20]. Similarly, pre-existing impairment without previous chemotherapy treatment should be considered[1]. In these patients, a more exhaustive assessment will need to be performed by an exercise professional prior to engaging in exercise interventions[20,24].

Chemotherapy is well known to cause anaemia and thrombocytopenia which carries a risk of increased bleeding, dizziness, fatigue, and dyspnea. Prior to endorsing participation in exercise, oncology nurses should consider their patient's blood counts and the extent of myelosuppression induced by their chemotherapy[9]. Further investigation and specialist advice should be sought in patients who are expected to have prolonged or significant myelosuppression[20]. Notably, combined with a nutritious diet, exercise has been shown to improve haemoglobin levels[9].

Increased fatigue is a well-known side effect of cancer and chemotherapy treatment and requires monitoring by the patient. When fatigue is particularly severe, exercise can be adjusted appropriately; however, it should remain part of the patient's routine, even at low intensities[9].

Physical restrictions resulting from previous surgical cancer treatments or pre-existing disability may cause a limited range of motion impeding the patient's ability to perform certain movements. Obtaining a thorough and accurate medical history will allow the nurse to recognise special restrictions. Referrals can be made to appropriate members of the multidisciplinary team to implement a modified exercise program[20].

Conclusion

There are proven benefits of vigorous and consistent exercise during chemotherapy treatment such as improved energy levels, mood, physical functioning, and possibly enhanced treatment response[4]. Historically, such activities have been discouraged due to lack of understanding and adequate research[11]. It is now understood that once certain considerations have been made of situations where certain exercises should be avoided altogether, exercise during chemotherapy is feasible, safe and beneficial. Oncology nurses in regular contact with patients receiving chemotherapy should have in-depth knowledge on this area of health intervention, allowing for education and implementation, leading to optimal patient outcomes.

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A qualitative study exploring 'nutrition'-related calls to a Cancer Helpline from people affected by cancer: what are they really about?

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Abstract

Background: People affected by cancer often have concerns about the role nutrition plays in cancer prevention, treatment or recovery. Telephone support services can act as a support mechanism for people to access credible information on a range of topics.

Aims: To explore the nature of nutrition-related enquiries to a telephone support service and the role of the oncology nurse in responding to these enquiries.

Methods: Nutrition-related calls from September to November 2013 were audited, transcribed and analysed thematically.

Results: From the 24 calls included, three key themes emerged: (i) Unmet needs revealed during contact; (ii) Nutrition as a conversation starter; and (iii) Nursing knowledge, intuition, assessment and scope of practice.

Discussion: People used nutrition queries as a tangible reason to initiate contact with the telephone support service. In the absence of non-verbal cues, nurses must 'listen between the lines' to recognise when deeper issues may be hiding behind more overt reasons for information seeking.

Keywords: Cancer information and support; nutrition; helpline.

Introduction

It is well acknowledged that care of the patient with cancer extends far beyond the provision of anti-cancer therapy[1,2]. The supportive care needs of patients are diverse and can span practical, informational and emotional domains[1-6]. Evidence suggests that if these needs are not met, or are not revisited frequently throughout a patient's trajectory, this can have detrimental effects on both a patient and their caregivers[2,4,6,7]. Despite this evidence, it is documented that patients and caregivers alike frequently report at least one unmet need at some stage in their cancer experience[2,4,6-8].

Telephone-based supportive care has been shown to be effective in addressing these unmet needs as it provides a highly accessible and cost-effective means of attaining information and support[9]. It provides privacy, anonymity and equity of access to services that otherwise may not be available to people affected by cancer, and thus can facilitate conversations that may be sensitive in nature, or not readily had in a face-to-face setting[5,10,11]. Despite telephone helplines being well-established as a platform for supportive care delivery[6], past research has focused primarily on the reasons callers might access a cancer helpline[12-14]. To date, little research has been done to further examine the effectiveness of helplines and the services they are positioned to provide to those affected by cancer[5].

Cancer Council services exist independently in each state and territory as part of a federation of non-government organisations

(NGOs) with Cancer Council Australia[6]. For 20 years, helplines have existed within Cancer Councils as a means for people to access cancer support outside of a clinical setting. Formerly called the 'Cancer Helpline', the service is now referred to as Cancer Council 13 11 20[6]. In Victoria, the service was implemented in 1993 as a core program of Cancer Council Victoria's Cancer Information and Support service, and aimed to increase access to a range of practical, information and emotional support programs such as peer support, counselling services and financial assistance for people affected by cancer[6,12]. Currently, Victoria's telephone support service is staffed by experienced oncology nurses, with calls routinely recorded for quality and training purposes. Nurses working on the line frequently draw on knowledge and experience from their current clinical environments to address the needs of callers[9]. Numerous issues are typically covered in a single call, with nurses then categorising these interactions into discussion topics using a standardised taxonomy. Approximately 3% of overall calls are categorised as nutrition-related.

It is established that approximately one-third of cancers are preventable[15], with poor diet considered second only to tobacco use as a modifiable risk factor[16]. Additionally there is convincing evidence of a link with multiple dietary components, cancer prevention and control[16,17]. Given this growing evidence, together with ubiquitous messaging about diet and cancer throughout multiple media channels, it is perhaps unsurprising that patients and carers have high interest in dietary modifications as a strategy to help avoid or manage a cancer experience[15-22]. Questions concerning diet and cancer are often raised during calls to the telephone support service, including enquiries about preventative diets, dietary management of symptoms, and foods to aid recovery. While nurses are able to provide general advice, the information required by an individual can often be quite complex, with little known about the nature of and response to these calls.

Aims

The aims of this quality improvement project were to explore:

1) the nature of nutrition-related enquiries received via Cancer Council Victoria's telephone support service; and

2) the role of the nurse in responding to these nutrition-related enquiries.

Methods

Setting, sample and design:

This quality improvement project adopted a qualitative design. Calls made to Victoria's telephone support service by patients or carers between September and November 2013 that were categorised as relating to the following topics were eligible for inclusion in the audit: 'diet and nutrition', 'dietitian' or 'weight management'. Calls that had minimal discussion about nutrition, or where direct questions about nutrition were not posed by callers were classified as miscoded and consequently were not included in the study. For example, this included instances where callers requested to be sent nutrition resources following discussion about more pressing issues. Thirty-eight calls were identified as being potentially eligible. On review of the data, 14 calls were excluded. This resulted in 24 calls being analysed.

Data collection

De-identified demographics of the sample were collated using reports obtained from Cancer Council Victoria's Customer Relationship Management (CRM) Database, Salesforce™. Audio recordings of calls were transcribed and de-identified by a nursing research student. Two calls (8% of the total sample) were additionally transcribed by the project manager (KL) and compared to the original transcription to ensure consistency and reinforce the accuracy of the original transcription. Any identifiable information within transcripts was removed, each caller was assigned a pseudonym, and each nurse identified was assigned a numbered code. This project was considered by the Cancer Council Victoria ethics committee and approved by the Institutional Research Review Committee as a suitable quality improvement project.

Data analysis

Preliminary analysis of the de-identified data was undertaken between September 2014 and May 2015. Using a qualitative descriptive approach, thematic analysis was performed to identify common themes in order to assess the nature of enquiries received and the information and support required by callers. A coding index was created, which was iterative in nature, and allowed themes to be categorised broadly in the first instance and then refined over time as definitions for each theme evolved and were finalised. Each researcher coded the same four randomly selected transcripts initially (10% of overall sample) to ensure consensus on how emerging themes were being labelled and identified. After coding this sample, the researchers reached agreement on emerging themes and then coded the remaining transcripts to form the final coding index. During this phase of the project, 11 themes, with 32 associated sub-themes were identified. The 11 original themes were later re-examined and refined by the authors, resulting in three broad, overarching themes and three sub-themes.

Table 1: Sample demographics (N=24)

Caller demographics	N	%
Gender		
Male	5	21%
Female	19	79%
Age range (years)		
≤ 39	0	0%
40–49	5	21%
50–59	6	25%
60–69	4	17%
70–79	3	12%
≥ 80	2	8%
Unknown	4	17%
Caller type		
Patient	12	50%
Caregivers (family/friends)	11	46%
General public	1	4%

Results

Calls were predominantly made by patients (n=12; 50%) or carers (n=11; 46%). One call was made by a member of the general public (n=1; 4%), with a question relating to diet and cancer risk (Table 1).

This paper presents on three broad themes and associated subthemes that arose from the data:

(i) Unmet needs revealed during contact;

(ii) Nutrition as a conversation starter; and

(iii) Nursing knowledge, intuition, assessment and scope of practice.

1. Unmet needs revealed during contact

Although calls had been audited as relating to diet and nutrition, it became apparent that callers' needs were often complex and multifaceted; with nutrition-related content rarely occurring in isolation. Most callers revealed persistent unmet needs not previously addressed by their health care team that they hoped would be resolved in some way by calling the telephone support service. This was irrespective of the caller's point in the cancer experience and ranged from new diagnoses through to palliative and end-of-life discussions.

Sub-theme: Fear, anxiety and uncertainty

'Fear' was a predominant theme throughout and was often illustrated in discussion about both nutrition and non–nutrition related concerns, such as treatment side effects, complex family or carer dynamics, or practical and financial concerns.

> *"A lot of the doctors that I'm talking to aren't really telling me very much. They're not telling me what I should be doing, and what I shouldn't be doing … I'm just frightened because there's so many of them. If there was one particular* [soy] *product that I knew that was okay to have I would include that in my diet"* (Call 1, patient)

> *"It's very challenging when something like this is happening and you're not kind of there* [at the appointment] *and you're not in control … I think once he* [my father-in-law] *started reading the list of side-effects, it sort of freaked him out."* (Call 10, caregiver)

Sub-theme: Information needs specific to their situation

In instances where nutrition was the primary focus, it was raised in the context of the caller seeking clarification or clearer answers to their questions. Whether the call was from a patient or carer, most concerns were in part related to the interaction between diet and cancer, and the role it might play in enhancing a person's treatment or recovery, or in influencing the chance of remission or recurrence.

> *"Is there any connection between diet and getting cancer in the first place? And, is there any evidence that changing your diet can actually send you into remission?"* (Call 5, patient)

Sub-theme: Space to vent and access support

While it was common for callers to seek answers about both nutrition and non–nutrition related concerns, this need for information was often intertwined with a need for emotional support. In some cases the caller used the service as a platform to vent and be heard.

> *"Hi, I was wondering if you could help me … I'm probably going to rant and rave a bit and I apologise"* (Call 16, patient)

2. Nutrition as a conversation starter

When nutrition was raised in discussion, it often acted as a starting point for callers to then segue into discussing more sensitive or emotional concerns, such as effects on intimate relationships, overall prognosis or challenges faced by a carer. These emotional concerns were either raised directly by the caller after a rapport had been built or came about organically as a result of the dialogue between nurse and caller.

> *"I was thinking of talking to* [the dietitian] *about it. But I don't know whether these people can add value to a situation like gastroparesis or not. Or whether they're more for people who are dieting for health, or all sorts of reasons … I guess what I was ringing to ask you — you'd get a lot of people* [with] *various presentations of this sort of cancer — what*

> *is the longer term outlook for people with gastroparesis? … I take on board what you say. Each one is an individual, but people who have gastroparesis; do they have a limited life span because of it?"* (Call 17, patient)

This caller initially asked about the effects of gastroparesis generally on their health. Further into discussion, it was found that their main concern was whether this condition affected their overall prognosis, moving the conversation to a deeper discussion about the emotional impact this was having on them.

One caller began by asking advice of alternative foods they could prepare for a friend they were supporting, but then segued into discussion about the frustration they were feeling and the toll that this responsibility was having on them.

> *"I did some sweet potato and pumpkin … but she didn't eat that … I had a conversation with her yesterday about how I was feeling. My friend's been a counsellor for 35 years, and I'm a nurse.* [It] *didn't go as well as I'd hoped. She got really annoyed with me and asked what I expect from her. I said 'we've both got expectations, I'm trying to really help' … Oh I'm really stuck between a rock and a hard place".* (Call 13, caregiver)

3. Nursing knowledge, intuition, assessment and scope of practice

This theme encompassed different communication techniques used by the nurse and included assessing where nutrition-related questions sat within the caller's overall hierarchy of needs and concerns that were raised. One caller's initial question related to the whether or not they could consume soy products, as they had heard there was possible interaction between soy products and oestrogen production. Further into discussion, it became apparent that the caller had misunderstood the information they had heard about sex and oestrogen production being a possible trigger for cancer recurrence, and this had inhibited their physical relationship with their partner. On questioning, it became clear that this was actually the more important concern for the caller, so the nurse then prioritised and focused on relationship changes for the remainder of the discussion, whilst also correcting any misunderstanding about soy and cancer recurrence.

> *Caller: "My main concern is what should I eat and what shouldn't I eat? I've been told to stay away from soy beans …"*
>
> *Nurse: "Why do you think you shouldn't be having soy?"*
>
> *Caller: "It can cause you to produce more oestrogen … my cousin has it* [breast cancer] *as well, her doctor told her she can't have sex because she'll produce a small amount of oestrogen and that's not good for her. I have heard and read so many different things. I'm so confused … I mean, I'm married, and part of being married is sex. I know that I shouldn't be having sex and things like that. What do I do?"*
>
> *Nurse: "Potentially* [your cousin's] *misunderstood what he said to her, but there is no reason to avoid having sex …"* (Call 1, patient)

Acknowledging emotional cues, providing reassurance, education, validation and empathy to the caller was also seen throughout nutrition-related calls, and in most cases this appeared to leave the caller feeling heard, empowered and supported.

> *Caller: "This oncologist just really confused and upset me and I'm thinking, 'what should I be doing?'"*
>
> *Nurse: "I think that's a really important thing … sometimes it's not easy and even people have a really strong sense of self and self-esteem can get thrown … words are powerful, especially when they come from nurses and doctors. It's not unusual to feel really thrown by something. But I really want to commend you. You've taken control. You've taken control and you've rung and spoken with us. You're looking at ways to deal with the situation. That's a great way to face anything …"*
>
> *Caller: "You've given me a lot to think about, thank you so much".* (Call 4, patient)

Nurses utilised their knowledge and expertise to educate, reinforce or expand on information already received, or to provide basic information that had not previously been given by the health care team. This included information about dietary supplements, whether sugar or soy had any impact on cancer treatments, or basic advice in managing changes in appetite. Where nutrition information required fell outside of the nurse's scope of practice, referrals were made to external services, including dietetic services and reputable web-based or hardcopy information, to ensure individuals' needs were addressed.

> *Nurse: "The other option you've got is to … see a dietitian. I'm wondering if that's something you'd like to explore? Because if the antidepressants are working for you and you can maintain your weight, by speaking with a dietitian, that might be able to* [assist] *at the same time."*
>
> *Caller: "Yeah, I never thought of that*
>
> *Nurse: That's alright. That's what we're here for".* (Call 17, patient)

Discussion

This study aimed to understand the nature of nutrition-related calls made by people affected by cancer and explore the nurses' role in responding to these queries. Callers often made contact with the service due to an unmet or underlying emotional, practical or informational need. Callers specifically highlighted the lack of emotional support they had received in previous interactions with their specialist or health care teams, and this appears to support previous findings that a person's emotional and informational needs are often linked[8]. Nutrition-related concerns were raised either directly or indirectly with the nurse, and were in most instances raised amongst discussion around emotional or practical issues. Nurses then utilised their intuition and assessment skills to prioritise these nutrition-related questions within a caller's hierarchy of needs. In instances where diet and nutrition were raised explicitly, it appeared that this was often due to it being a tangible, easy to name question; something that could be controlled, that then segued directly or indirectly into more complex or underlying concerns such as fear, mortality, intimacy, loss of control, family dynamics or patient–carer relationships[2]. It is important to note that in many cases it seemed that if the emotional or practical issues were unpacked and addressed in the first instance, this often dissipated or addressed the initial 'nutrition'-related query simultaneously.

This study supports existing evidence that nurses play a key role in promoting healthy eating to those affected by cancer, and this information provision should be underpinned with sound training on this specific aspect of supportive care delivery. Where nutrition-related questions were outside of the nurses' scope, they were required to know when and how to assist patients and this often involved directing callers to more specialised external services, such as dietitians, when needed[15].

This finding becomes important in the context of existing evidence that shows supportive care is most needed, but is also most deficient at time points where a caller was not in direct contact with the hospital, treatment or allied health teams[2]. Evidence also shows that the vast majority of those affected by cancer hope to have their information needs met by their specialist; however, needs were not always met to the degree a patient needed[3]. This is where a service such as Cancer Council's 13 11 20 telephone support service can play a vital role in assisting to bridge this important supportive care gap[8,23].

Recommendations and future directions

In order to effectively address callers' concerns, nurses working in this environment must be able to 'listen between the lines', to accurately deduce underlying needs and emotions being expressed, that may be hiding behind nutrition-related questions. They play a vital role in identifying and addressing previously unmet needs and supporting people affected by cancer outside a clinical setting across a range of topics, and do so in an environment that provides callers with time, space and privacy to foster in-depth discussion[24].

This study provides a foundation for further research into the nature and importance of support services such as Cancer Council 13 11 20 and its ability to explore, identify and address the unmet supportive care needs of people affected by cancer. Using transcribed call recordings to explore the nature of enquiries received and how these are responded to is a feasible method of quality improvement. Future research could utilise this method to further explore the nurse–caller dynamic in this setting. Given the information that is collected routinely via 13 11 20, research could also consider the impacts of a caller's socio-economic status and geographical location, to understand if this influences needs and drivers for contacting such a service.

This study identified changes that could be made in terms of how calls are categorised within Cancer Council Victoria's CRM database to ensure they are a true reflection of what occurred during an interaction, and how these changes were implemented at the completion of this project. Nurse induction and ongoing training for staff should continue to focus on the importance of well-developed communication and referral skills. It should also encourage nurses to consider whether deeper issues may be hiding behind more overt reasons for information seeking such as questions about diet and cancer or other more practical issues. This will allow nurses to be able to provide information and support that is appropriate to the caller in the context of their specific situation, and may be relevant to all nursing settings.

Limitations

The qualitative nature of this quality improvement project was employed to explore the experiences of callers to a telephone support service with regard to diet and nutrition-based concerns or queries. As such, the influence of age, gender, cancer type and other demographic information on information seeking was not able to be examined, and would require a mixed-methods approach. The findings are representative of Cancer Council Victoria's service, and further studies would be needed to test applicability in other telephone support settings.

Conclusion

This study has shown that calls on the subject of 'nutrition' are rarely about nutrition alone. Indeed callers' needs for 'nutrition'-related information and support are often linked with their unmet emotional needs, and these needs are often complex and multifaceted. In many cases it was demonstrated that callers seek information under the guise of nutrition or other such pragmatic topics and this can often mask deeper unmet emotional needs that are then revealed throughout a conversation. The role of a telephone support nurse in addressing a caller's needs is complex and varied, and diet and nutrition is just one subject of many that can be covered within a single call or interaction. Nurses working on the line are therefore required to work with a caller to truly understand what it is they are really asking for, or in need of. In conversations where true nutrition-related concerns are raised, or where specific dietary advice is required, nurses then triaged callers to appropriate services and these were mainly seen to be hospital or community-based dietitians who could provide tailored advice and management plans.

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An integrative review on non–patient related factors of peripherally inserted central catheter (PICC) infections in hospitalised adult patients

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Abstract

Introduction: Peripherally inserted central catheter (PICC) has been recognised as an effective and safe vascular access device. There is a range of devices and management methods in regard to PICC, yet there is little synthesis of the evidence around non–patient related factors of PICC infections to provide an evidence-based guide for clinicians. This integrative review aimed to identify the non–patient related factors that influence PICC infections in adult patients.

Method: An integrative review was conducted across online databases.

Results: Twenty-five articles were analysed to identify non–patient related factors that influence CRBSI rates. The catheter type, insertion technique and maintenance were key factors in the infection rates in PICC.

Conclusion: This integrative review highlighted the importance of considering non–patient related factors to achieve the lowest PICC infection. There is a need for high-level studies to investigate non–patient related factors in preventing PICC infection to increase the evidence base.

Introduction

The peripherally inserted central catheter (PICC) has been recognised as an effective and safe vascular access device over the past few decades, resulting in a steady increase in its use for intermediate and long-term venous access[1]. Compared to the central venous catheter (CVC), the PICC is associated with fewer procedural and later systemic complications[2,3]. The management of PICCs can be undertaken by experienced and credentialled nurses thus benefiting the health care system, with fewer insertion delays and decreased cost compared to CVCs. In addition, the PICC can be inserted in a range of settings outside critical care units and operating theatres, again highlighting its importance[4]. However, the PICC is not free of complications which are influenced by both patient-related and non–patient related factors in relation to infection rates.

Background

The known complications of PICCs include infection, vein irritation, thrombosis, catheter occlusion and breakage[5,6]. Catheter-related blood stream infection (CRBSI) remains a major complication of PICCs, resulting in substantial increase in mortality and morbidity and associated expenses[7]. The incidence of PICC-related blood-stream infection (BSI) varies from 0.47 episodes/1000 catheter days to 4.79 episodes/1000 catheter days[8,9]. Interestingly, some studies found equal or higher incidence of PICC-related BSI than CVCs and question the use of PICCs as the single means for CRBSI prevention[2,10]. The cost of CRBSI was estimated to be between US$3,124 to US$60,536 per event due to treatment and length of hospitalisation, highlighting the need to understand the non–patient related factors involved[11,12]. This review investigates the non–patient related factors such as type of catheter, insertion technique and maintenance care to highlight differences which can influence CRBSI rates in PICCs.

The main routes of PICC contamination are intraluminal and extraluminal contamination of the PICC, which can occur during or after insertion[7,13,14]. Intraluminal contamination occurs when the PICC hub becomes contaminated with microorganisms from the skin of the patient or from the hands of health care workers. Migration of microorganisms, either from the patient's skin through the catheter tract or from inadequate decontamination of the skin prior to PICC insertion, leads to extraluminal contamination[13,15]. Sometimes the PICC can get infected haematogenously from another source of infection in the body or by contaminated infusate[7].

Patients with PICC infections can present with signs and symptoms of exit site infection, systemic infection/CRBSI or a combination of both[16]. Clinical manifestations for systemic infection include positive central and peripheral blood cultures and a positive catheter tip culture with or without pyrexia[5]. As the exit site infection itself can lead to systemic infection by migration of the microorganism through the external catheter surface[9], it is very important to identify the exit site infection and treat as early as possible. In the current literature, the definition of CRBSI is often interchanged with catheter line-associated blood stream infection (CLABSI). In this context, articles analysing CRBSI, CLABSI, exit site or systemic infections were included for this review.

PICC-related infection remains a major concern, highlighting the importance of identifying the contributing factors to enable the development of recommendations to reduce PICC infections[17]. Previous studies have identified contributing factors to CRBSI and discussed the role of multiple interventions in preventing CRBSI[14,18-25]. The non–patient related factors that influence PICC infections among adult hospitalised patients are not well defined, leaving a gap in the literature. Most research exploring CRBSI has been with CVC and peripheral intravascular catheters and the sample patients have mainly been neonates, infants or children, leaving limited available data regarding PICC infections among adult hospitalised patients. The aim of this integrative review was to identify the non–patient related factors that contribute to PICC infections.

Objectives of this review included:

1). Conduct an extensive literature review on catheter-related infection among hospitalised adult patients with PICCs.

2). Identify non-patient factors that promote the reduction or elimination of PICC-related infections in hospitalised adult patients.

3). Identify gaps in current practice.

Non–patient related factors, including sterile techniques, PICC insertion methods, type of PICC and number of PICC lumens, that can be controlled or modified by interventions, were the focus of this study. Patient-related factors such as age, gender, diagnosis and associated comorbidities were not the subject of this study as they are not controllable or modifiable by interventions.

Method

An integrative review was used to explore the non–patient related factors of PICC infection. Integrative review is well known for promoting a comprehensive understanding of a problem by allowing inclusion of qualitative, quantitative and mixed methods of research designs[26]. The Whittemore and Knafl framework was adapted for this review, which includes problem identification, literature search, data evaluation, data analysis and presentation[26]. The inclusion and exclusion criteria used for the article selections are listed in Table 1

Table 1: Inclusion and exclusion criteria

Inclusion criteria	• English language: 2000–2016 [since late 1990s witnessed emergence of evidence-based CRBSI prevention practices] • Includes factors influencing the PICC-related infection. • Studies CRBSI among central venous access device (CVAD), provided it clearly states the number of PICC line insertions among total CVC, CRBSI associated with PICC lines and factors related to PICC BSI/CRBSI • Published in a peer-reviewed journal
Exclusion criteria	• Studies/articles solely including neonates or children • Articles/studies only addressing CRBSI associated with CVC.

Search strategy and outcome

A search was completed using PubMed, CINAHL, Cochrane Library, PROQUEST, Trip, National Library of Science and Medline. The keywords and combinations used to perform the search were 'PICC infections or BSI', 'CRBSI', and 'non patient factors'. See Table 2 for definition of research terms.

Table 2: Definition of research terms used in this review

Research term	Definition
PICC-related infection	Any infection that results from insertion of or as a result of existing PICC. May include: PICC infection, PICC BSI, PICC exit site infection.
CRBSI	CRBSI is the presence of bacteraemia resulting from an intravascular device. May include: catheter-related sepsis, catheter-associated BSI, central line-associated blood stream infection (CLABSI)
Non-patient factors	Any factor that is not related to patient characteristics such as age, sex, diagnosis or underlying morbidity. May include: PICC material, number of lumens, presence of valve, PICC insertion methods, dwell time and PICC care practices.

The initial search revealed 3498 articles. The articles were initially selected based on their title and abstract. Articles meeting inclusion criteria were obtained and further assessed. In order to maintain the validity of the review, possible broad search terms were used to search the articles. Twenty articles were selected from the electronic data base that met the inclusion criteria. Ancestry method was used to identify the potential research articles that were not listed in the initial database search. This was performed by reviewing the reference list of the articles that met the inclusion criteria. This resulted in addition of five articles. A total of 25 articles were selected for this review. See Table 3 for summary of articles including Mixed Methods Appraisal Tool (MMAT) scores.

Data evaluation/quality appraisal

The MMAT version 2011 was used to appraise the quality of eligible studies[27]. The reliability and efficiency of MMAT is supported by previous studies and is considered a critical appraisal tool for assessing qualitative, quantitative and mixed-methods studies scoring in relation to the methodological quality to address the research question[27]. The five-point scoring zero, 25, 50, 75 or 100% identify how the research meets the criteria, with 100% being all criteria met. The selected studies were assessed and scored by two reviewers with an independent reviewer for consensus when needed. All eligible studies were included irrespective of their MMAT score.

Data analysis and presentation

As classifying the selected articles based on its evidence-based strength helps towards critically analysing the research[26,27], the selected studies were rated and presented in Table 3. To provide clarity for analysis, the data was presented using different characteristics, including author, year, aims, design, sample method, size, variables or interventions, outcomes, limitations and MMAT score. The identified factors were categorised into three groups based on its relation with PICC selection, insertion and maintenance.

Results

Study characteristics

The selected articles were published between 2000 and 2016, with the majority of them published since 2006 (16%) and 2011 (76%). The selected studies were conducted and published in different countries. Among them, 10 of the studies were published from the United States of America (USA), with three each from Italy and the Republic of China. The other studies were completed in Canada, Japan, Spain, Taiwan, United Kingdom and one international study. The research method and quality of the selected studies was also different. Among the 25 studies, only five of them were randomised controlled studies. The majority of the studies (n=20) employed a quantitative non-randomisation method. Of the selected studies, 20 had 100% score according to the MMAT scoring scale.

The sample sizes of the studies varied, ranging from 26 to 2193 PICC insertions. Based on its relation to the time of PICC placement (that is to say, before, during or post-PICC insertion), the identified studies have been categorised into three groups: studies acknowledging factors related to PICC selection; PICC insertion; and PICC care or maintenance. Figure 1 illustrates the summary of the factors identified in this study.

Summary of information

a) Factors related to PICC selection

There were 17 studies that examined the factors related to PICC selection that influenced PICC infection. A majority of

Figure 1: Non–patient related factors influencing PICC infection

Factors related to PICC selection

- Antibiotic-impregnated PICC
- Number of lumen
- PICC material
- Presence of valve
- Type of PICC

Factors related to PICC insertion

- Catheter tip in the lower third of superior vena cava
- Care bundles — hand scrub for minimum of 2 minutes, maximal barrier precautions, strict sterile technique for PICC insertion
- Compliance of PICC operator with care bundles
- Modified Seldinger technique
- Nurse-led PICC insertion
- PICC insertion in ICU
- Prior PICC insertion
- Right-sided insertion
- Upper arm placement
- USS-guided insertion

Factors related to PICC care and maintenance

- Dedicated central vascular access device team
- Delay in PICC care
- Education and training of staff
- Long dwell time of PICC
- Multidisciplinary team and nursing leadership
- PICC assessment and care
- Strict aseptic technique during dressing change
- Sutureless securement devices
- Use of chlorhexidine preparation and use of strict aseptic technique during dressing change

the studies (n=15) had an MMAT score of 100%. The remaining two studies scored 75% and 50% respectively. The identified non–patient related factors associated with PICC selection included the type and material of the PICC[5,28-30], the number of PICC lumens[17,29-31], the presence of a valve[32-34] and whether the PICC was antibiotic-impregnated/coated[9,35,36]. Though the presence of a valve and the type and material of the PICC showed mixed results with regard to PICC infection rates, the antibiotic-impregnated PICC and fewer lumen demonstrated a strong relation with reduced CRBSI incidence[17,29-31,33,35].

b) Factors related to PICC insertion

Factors influencing PICC infection rates during insertion were explored by 10 studies. Seven of the selected studies had an MMAT score of 100%, with the remaining three studies scoring 75. The influencing factors for PICC infection included ultrasound-guided PICC insertion and use of the Modified Seldinger technique (insertion using sheath and guidewire) for PICC insertion[37,38]. The position of the PICC tip in the lower third of the superior vena cava[39,40], anatomical position of the PICC insertion site (such as upper arm PICC placement)[38] and right-sided PICC insertion[39,41] influenced infection rates. Factors such as prior PICC insertion[41] and PICC insertion in ICU[8,17,30] increased the risk of infection. Though right-sided PICC insertion, prior PICC insertion and insertion in ICU were associated with increased CRBSI, the remaining factors, especially compliance of the operator with care bundles and ultrasound-guided Modified Seldinger technique, were the main factors promoting reduction in CRBSI[37,38,42,43].

c) Factors related to PICC maintenance

Ten of the studies identified non–patient factors related to PICC maintenance that influence PICC infection rate. All of the studies had an MMAT score of 100%. The factors related to PICC maintenance include delay in catheter care and longer dwell time[17,30,33], use of a sutureless securement device[40,44], education and training of the staff[36,45,46], a multidisciplinary team (including medical staff)[43], and nurse-led team[8,47,48]. Other than delay in catheter care and longer dwell time, all other factors showed a positive influence in reducing CRBSI.

Discussion

This integrative review investigated the role of non–patient related factors in prevention of PICC infections. The selected studies have shown that either adaptation or elimination of such factors can reduce CRBSI and local infection associated with PICCs. The identified factors have been summarised in Figure 1. Use of a maximal sterile barrier including 2% chlorhexidine, prior insertion and post-insertion aseptic technique still remains the basis for infection prevention[29,46]. Though it was not the variable, most studies included in this review used strict sterile field techniques.

This integrative review identified antibiotic-impregnated PICCs as a factor that reduces PICC infection[9,35,36]. However, despite no reported evidence of bacterial resistance, the emergence of resistant pathogens remains a major concern for the use of antibiotic-impregnated PICCs[35]. The Centers for Disease Control and Prevention recommends the use of antibiotic-impregnated PICCs only if the risk of CRBSI remains high after successful implementation of a comprehensive strategy for infection prevention[7]; including skin preparation using alcohol-based antisepsis with more than 0.5% chlorhexidine, maximal sterile barrier precautions and education of staff who insert or care for the catheter[7]. If the patient remains at high risk for CRBSI because of their underlying comorbidity status, even a single episode of CRBSI could be fatal. Further high-level evidence studies are needed to identify the role of antibiotic-impregnated PICCs in the prevention of CRBSI among high-risk patients and to exclude the risk of resistant pathogens.

This integrative review found conflicting results regarding the role of different PICC types such as silicone versus polyurethane PICCs, valved versus non-valved PICCs or standard cap PICC in preventing PICC infection[34,39,49]. Catheter material like silicone is known to promote adherence of microorganism to the PICC surface, leading to microbial colonisation and infection[7]. A study published in 2009[33] failed to identify any statistical difference in PICC infections rated between PICCs with a positive pressure valve (PPV) versus those with a standard cap. In the following year, another study[39] showed an increased CRBSI rate with silicone PICCs compared to polyurethane PICCs. However, the PICCs were different in structure; the silicone PICCs had a distal valve, whereas the polyurethane PICCs had a proximal valve. A randomised control trial (RCT) published in 2012[49] also compared infection rates between silicone and polyurethane PICCs and found no relation between catheter material and infection rate. The RCT published in 2014[34] also concluded that there was no relation between presence of a valve and CRBSI. The heterogeneity among these study samples emphasises the need for further investigation to understand the multiple factors related to catheter type.

The delay in dressing change was identified as a risk factor for PICC-related infection. Choosing semipermeable transparent dressing and changing it at least every seven days is considered as ideal for PICC dressing changes unless the site is oozing/bleeding or the patient is diaphoretic, when using a sterile gauze dressing and changing it every second day[7]. Daily insertion site assessment and recording the findings helps in the early identification of signs of infection[13].

These integrative review findings support the theory that the dwell time is a risk factor for CRBSI. Research has demonstrated that the longer the PICC is in situ, the higher the incidence of CRBSI[17,30]. Practices such as not removing the PICC until patient discharge from hospital or forgetting the patient has a PICC can significantly increase the risk of CRBSI[50]. Health care workers need to be vigilant about assessing ongoing need for the PICC and removing it if it is no longer needed[2,51]. Research has demonstrated that the dwell time and number of lumens are directly associated with increase in CRBSI[17,30]. Though it was not the primary outcome, the quasi-experimental study by Khalidi *et al.*[33] showed an increased incidence of CRBSI in double lumen PICCs with longer dwell times.

The density of skin flora at the insertion site is a major CRBSI risk factor[7]. Among adult populations, PICCs are usually inserted in the cephalic, basilic or brachial veins of the arm[7]. Compared with the cubital fossa, the upper arm is considered to be less colonised with bacteria as it has fewer sweat glands[41]. In addition, PICCs placed in the upper arm are associated with minimal in and out movement, thus reducing the transfer of skin flora to the deeper layers[38]. A study published in 2010 compared the relation of CRBSI with the arm or vein used for PICC insertion, but failed to find any difference in the CRBSI rates in regard to the arm or vein used[39]. However, another study published in 2011[41] showed an increased risk in the incidence of CRBSI associated with right-sided PICC insertions. Though this study did not specify the dominant hand of the patients, this could possibility support the increased risk of infection associated with right-sided placement, where right-handed people use their dominant hand more, resulting in an increased chance of PICC movement. The person who inserts the PICC should consider dominant arm and arm position as influencing factors while selecting the site.

As the use of ultrasound sonography facilitates identification of the right-sized vein, it reduces the risk of failed insertions and inserting a large bore line into a small vein[16,52], which is associated with increased risk of thrombosis, and in turn increases the risk of CRBSI[16]. Adoption of ultrasound-guided PICC insertion and the provision of training for personnel may result in better patient outcomes. Future high-level research on the effect of ultrasound-guided PICC insertion on CRBSI is warranted.

Implications for nursing practice

Nurses play an integral role in identifying and preventing PICC-related infection, from the pre-insertion period to removal of the PICC[13]. Use of maximal barrier precautions, antisepsis and adhering to aseptic technique post-insertion remains the basis for infection prevention[7,9,29,46]. Research has shown that the education of nurses on PICC management plays an integral role in reducing PICC infections[31,45]. Ensuring adherence to best-practice guidelines and providing aggressive educational programs are considered effective means for the prevention of CRBSI[53]. In addition, standardised practices for PICC care and maintenance are also important in preventing PICC infection[31,47]. In this context, the role of nursing leadership and education is very important to promote staff compliance with the guidelines and ensuring that the best practices are implemented[9,54].

Limitations

Limitations of this review include heterogeneity of the studies and incomplete reporting. Two of the studies included in this integrative review were supported by industry funding[8,17], which might potentially affect the validity of its outcome. Differences in PICC techniques and comparison of PICC types influenced the ability to compare research findings and draw conclusions. In addition, exclusion of studies that included the neonates/children, studies published in non-English languages and studies that exclusively addressed CRBSI in CVC might have also contributed to incomplete reporting.

Future research

Future research to build evidence regarding the influence of different non–patient related factors for minimising PICC infections would increase the understanding in this area. There is a gap in the literature regarding the factors contributing to local/exit site PICC infections and the measures to prevent or minimise it. There is also the need for further studies to identify the role of multiple non-patient factors in preventing infections associated with PICCs.

Conclusion

This integrative review identified the role of non–patient related factors such as PICC selection, PICC insertion and PICC maintenance in preventing or minimising PICC infections among adult hospitalised patients. The findings from this integrative review highlight the importance of considering these factors towards achieving the target of zero infection among patients with PICCs. This integrative review also emphasised the role of nurses and nursing practices in preventing PICC infections in hospitalised patients. Health care workers should be aware of the factors that favour prevention of PICC infections. Health care managers should make sure that the staff is aware of the preventive strategies and that adequate resources for CRBSI prevention are readily available. This integrative review identified the need for high-level evidence to identify the influence of non–patient related factors in PICC infection prevention.

Table 3: *Summary of selected articles*

Author/year Country	**Design**	**Aim**	**Setting/ Sample**	**Variables**	**Findings**	**Limitations**	**Industry funding/ Conflict of interest**	**MMAT**
Ajenjo *et al.* 2011[8] USA	Retrospective cohort study	Assess the incidence of PICC BSI and effect of discontinuation of intravenous therapy service on PICC use and PICC BSI rates	495 PICC insertions	Patient and treatment factors	Higher PICC BSI in ICU	PICC inserted by Nurse led team, thus institutional PICC practice may differ	Financial assistance — yes Nil conflict of interest	100
Alexandrou *et al.* 2012[48] Australia	Case study	Review the characteristics and outcomes of nurse-led CVC insertion	4212 CVC, including 1635 PICC insertions	CVC-related complications associated with nurse-led insertions.	Synergy between medical and nursing staff or developing new roles focusing on skills rather than profession can deliver better patient outcome.	Institutional PICC practice may differ	Nil	75
Armstrong *et al.* 2013[35] USA	Quasi experimental study	Assess the impact of antibiotic impregnated PICC lines on bacteremia in burns patients	49 PICC insertions	Antibiotic impregnated PICC	Antibiotic impregnated PICC lines decreases bacteremia in burns patients	Institutional PICC practice changed over time	Nil	50
Baxi *et al.* 2013[29] USA	Retrospective cohort study	Identify the effect of post insertion adjustment on CRBSI	2,193 PICC insertions	Post placement adjustment, CRBSI rates	No relationship between post insertion PICC adjustments and CRBSI. Increased risk of infection with higher number of PICC lumens Increased risk of CRBSI with Power injectable PICC	Incomplete reporting of influencing factors including comorbidities	Nil	100
Burrell *et al.* 2011[42] Australia	Case study	Reduce CRBSI	10507 CVC insertions including 1467 PICC insertions	CRBSI, compliance with aseptic CVC insertion	Lower CRBSI with aseptic care bundles Five times increased CRBSI rate among PICC group inserted by clinician non-compliant with care bundles	Reporting error from self-reporting Problem with identification of CRBSI Minimal number of PICC insertions compared to the total insertions	Nil	
Chopra *et al.* 2014[30] USA	Retrospective cohort	Examine the pattern, incidence, timing and predictors of PICC BSI	966 PICC insertions	Patient, provider and device characteristics, CRBSI	Patient comorbidities, dwell time, health professional factors influenced CRBSI rate Higher number of PICC lumens associated with earlier onset of CRSBI	High number of male patients in cohort Patient treatment and comorbidities influenced BSI rates not clearly reported.	Nil	100
Curto-Garcia *et al.* 2016[43] Spain	Prospective case study	Investigate implementation of multidisciplinary approach to PICC care and PICC-related complications	44 PICC insertions	Change of insertion and maintenance guidelines	Decreased CRBSI and other complications Multidisciplinary approach for PICC care may reduce CRBSI	Institutional PICC practice may differ Patient treatment and comorbidities influenced BSI rates not clearly reported	Nil	100

Author/year Country	Design	Aim	Setting/ Sample	Variables	Findings	Limitations	Industry funding/ Conflict of interest	MMAT
Gao *et al.* 2015[40] Republic of China	3-year prospective cohort study	Identify the patterns, prevalence and risk factors for CRBSI associated with PICC	912 PICC insertions	Multiple variables (17)	StatLock fixing and PICC tip position in lower one-third of superior vena cava were associated with lower CRBSI PICC insertion in summer and catheter care delay were associated with increased CRBSI	Only single lumen PICC were used	Nil	100
Hoffer *et al.* 2001[32] USA	RCT	Evaluate benefit of PICC with proximal valve against PICC with distal valve in regard to the incidence of occlusion, infection or malfunction	100 PICC insertions	PICC with distal and proximal valve, PICC complications	Lower incidence of infection with proximal valve	Small sample number	Nil	100
Khalidi *et al.* 2009[33] USA	Quasi-experimental study	Compare the infection rate between PPV and standard PICC caps	160 PICC insertions	PPV versus a standard cap without PPV	No statistical difference in the occlusion, dwell time and CRBSI rate. Double lumen catheters had significantly longer dwell times.	Small number of participants might have affected the study outcome Institutional PICC practice may differ	Nil	100
Leung *et al.* 2011[45] Taiwan	Retrospective case study	Evaluate the factors causing failure of PICC	276 PICC insertions	Education on PICC maintenance	Decreased complication rates including CRBSI with adherence to educational guidelines	Patient treatment and comorbidities influenced BSI rates not clearly reported	Nil	100
Miyagaki *et al.* 2011[49] Japan	Prospective randomised trial	Compare PICC with two different material and tip design	26 PICC insertions	Polyurethane PICC with proximal valve and silicone PICC with distal valve	No difference in complication and durability between two groups	Small number of participants/PICCs RCT stopped due to Groshong Catheter withdrawal	Nil	75
Mollee *et al.* 2011[41] Australia	Prospective cohort study	Identify the risk factors for CRBSI among cancer patients	1127 CVAD including 807 PICC insertions	Risk factors for CRBSI	Increased CRBSI is associated with right-sided insertion, prior line insertions and CVC	Institutional PICC practice may differ Patient treatment and comorbidities influenced BSI rates not clearly reported	Nil	100

Author/year Country	Design	Aim	Setting/ Sample	Variables	Findings	Limitations	Industry funding/ Conflict of interest	MMAT
Morano *et al.* 2015[47] Italy	Retrospective cohort study	Assess the feasibility and safety of the use of PICC in patients with malignancies	612 PICC insertions.	Risk factors for CRBSI and catheter-related thrombotic complications	PICC is a safe and feasible alternative to other CVC in haematology patients Decreased CRBSI related to management of PICC by a dedicated CVAD team of doctors and nurses with standardised procedures for overall management of PICC	The study design might have resulted in reporting errors The experienced staff in the insertion and care of PICC line might have contributed to the lower infection rate	Nil	100
O'Brien, Paquet, Lindsay & Valenti 2013[31] Canada	Retrospective cohort study	Identify differences in lumen type and CRBSI rates	1,525 PICC insertions	PICC with single lumen and double lumen	Decreased rate of CRBSI with single lumen PICC	Incomplete reporting of influencing factors including comorbidities Institutional PICC practice may differ	Nil	100
Ong *et al.* 2010[39] International study	Prospective randomised trial	Compare proximal valve polyurethane PICC to a distal valve silicone Groshong in terms of infection, occlusion, thrombosis or malfunction	392 PICC insertions	Polyurethane PICC with proximal valve and silicone PICC with distal valve	Proximal valve polyurethane PICCs more durable. Distal valve silicone PICC groups more infections.	Unable to eliminate the operator-induced bias due to large number of patients	Nil	100
Pittiruti *et al.* 2014[34] Italy	RCT	Compare valved and non-valved PICC in terms of infection, occlusion, thrombosis or malfunction	180 PICC insertions	Valved and non-valved power injectable PICC	No clinical advantages of valved PICCs against non-valved PICC in terms of infection or occlusion	Study ceased due to PICC complications	Nil	100
Pittiruti *et al.* 2012[28] Italy	Retrospective case study	Evaluate the performance of power injectable PICCs	89 PICC insertions	Power injectable PICC	With a proper protocol CRBSI associated with power injectable PICC is similar to or lower than CVC	Limitation from study design	Nil	75
Pongruangporn *et al.* 2013[17] USA	Nested case-control study	Investigate device and patient-specific risk factors related BSI	647 PICC insertions	Patient and device-specific risk factors, PICC-related BSI	Dwell time, number of lumens and comorbidities influenced BSI	Institutional PICC practice may differ Patient treatment and comorbidities influenced BSI rates not clearly reported.	Financial assistance — yes Nil conflict of interest	100

Author/year Country	Design	Aim	Setting/ Sample	Variables	Findings	Limitations	Industry funding/ Conflict of interest	MMAT
Rutkoff 2014[9] USA	Quasi-experimental	Evaluate the effect of antimicrobial PICC, impregnated with chlorhexidine, on the CRBSI incidence	517 PICC insertions	Antimicrobial PICC, Unprotected PICC	Use of antimicrobial PICC with current infection prevention practices results in statistically significant reduction in CRBSI	Retrospective data for the non-interventional group used. Institutional PICC practice may differ	Nil	100
Simcock 2008[38] UK	Retrospective case study	Evaluate the effect of upper arm PICC placement and ultrasound guidance on PICC complication rates, success rate and longevity	944 PICC insertions	Upper arm placement, modified Seldinger technique and ultrasound guidance.	Ultrasound-guided upper arm PICC placement is associated with reduced exit site infection, thrombosis, catheter migration, increased success rate and longevity	Patient treatment and comorbidities not consistently reported. Institutional PICC practice may differ	Nil	75
Tavianini *et al.* 2014[36] USA	Case study	Evaluate the influence of a chlorhexidine-impregnated PICC in reducing CRBSI	100 PICC insertions	Chlorhexidine-impregnated PICC, staff education,	No incidence of CRBSI after the introduction of the chlorhexidine-impregnated PICC	Need for further study	Nil	100
Tian *et al.* 2010[46] Republic of China	Comparative case study	Evaluate the effect of multifaceted implementation of interventions in decreasing PICC-related complication	242 PICC insertions	Nurse education, PICC insertion technique and maintenance	Significant reduction in infective and non-infective complication of PICC with the multifaceted implementation strategies	Institutional PICC practice may differ Patient treatment and comorbidities influenced BSI rates not clearly reported	Nil	100
Yamamoto *et al.* 2002[44] USA	RCT	Assess the performance of sutureless securement adhesive device for securement of PICC	170 PICC insertions	Suter and StatLock	Significant reduction of CRBSI in StatLock group	Small sample numbers and incomplete follow up	Nil	100
Yuan *et al.* 2013[37] Republic of China	Prospective cohort study	Identify the appropriate PICC insertion technique by comparing complication and success rates with three different PICC insertion methods	597 PICC insertions	Standard insertion technique, non–ultrasound guided MST insertion, ultrasound-guided MST insertion	Lower incidence of PICC infections and thrombosis with ultrasound-guided MST insertion group.	Limitation from study design	Nil	100

Keys: BSI — Blood Stream Infection; CRBS — Catheter-Related Blood Stream Infection; CVC — Central Venous Catheter; MST — Modified Seldinger Technique; ICU — Intensive Care unit; PICC — Peripherally Inserted Central Catheter; PPV — Positive Pressure Valve; RCT — Randomised Control Trial.

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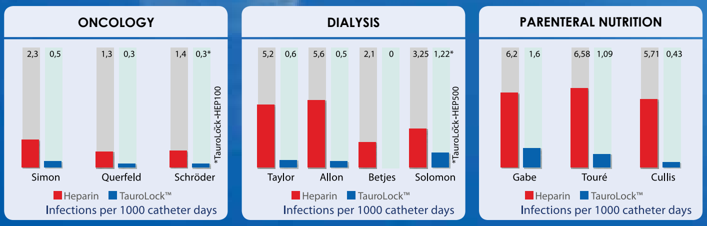

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