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Review

Models of nutrition-focused continuing education programs for nurses: a systematic review of the evidence

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Abstract. Nurses are well-positioned to provide basic nutrition education and reinforce nutrition messages to patients in hospital and primary care settings. Despite this, nurses may not receive adequate training to provide this service, and there is limited opportunity for nurses to engage in nutrition-focused continuing education (CE). The aim of this review was to determine whether nurse nutrition education results in improved knowledge and practices; and explore which models of CE for nutrition may be most acceptable and effective in practice. Web of Science and Scopus were searched for case-series studies published between 2000 and 2016 that investigated changes in nutrition knowledge of nurses and midwives. Only studies that could transcend to nurses providing patient nutrition education were included. Twelve articles met the eligibility criteria. Articles are explored in terms of mode of delivery, duration of intervention and educational strategies employed. Nutrition CE programs that are delivered face-to-face or by self-directed learning manuals, which utilise active learning strategies, are positively associated with improvements in nutrition knowledge. Web-based CE and self-directed learning may be favourable modes of delivery as they may assist in addressing resource and time contraints.

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Introduction

Globally, unhealthy diets are a leading risk factor of deaths and disability, with nearly one-tenth of the world's disability adjusted life years (DALYs) being attributable to dietary behaviours (Forouzanfar *et al*. 2015). Dietitians are recognised as experts in providing medical nutrition therapy in Australia, the UK, USA and Canada; however, they remain a relatively small workforce both in hospitals and primary care (Australian Institute of Health and Welfare 2009; Ball *et al*. 2013).

Conversely, nurses working both in hospitals and primary care settings have frequent and multiple patient encounters and are therefore uniquely placed to provide basic nutrition education to patients as part of routine care (Halcomb *et al*. 2008; DiMaria-Ghalili *et al*. 2014). Nurses are seen as trustworthy, and often have good rapport with patients (Halcomb *et al*. 2007; Cass *et al*. 2014). It is recognised that nurses have an important role to play in health promotion and nutrition education activities (DiMaria-Ghalili *et al*. 2014).

There is some limited research available, which suggests that lifestyle education provided by nurses in routine community care results in patient behaviour change and improved risk factors. A systematic review of interventions to reduce cardiovascular disease (CVD) showed that nurse-led interventions generally had positive effects on dietary risk factors and increased physical activity levels (Halcomb *et al*. 2007). Similarly, nurse-led education interventions on nutrition risk factors and weight loss have shown positive results in patients' readiness to change (Harris *et al*. 2013), as well as small reductions in patients' weight (Usher *et al*. 2013). Training programs that upskill nurses on lifestyle-related topics, including nutrition, have resulted in an increased frequency of nurses providing brief interventions for physical activity and nutrition with clients (Chan *et al*. 2013). This is in addition to increased and sustained referral rates by nurses to other healthcare providers for lifestyle counselling (Chan *et al*. 2013).

Despite their prime position in primary care, it has been recognised that globally (Warber *et al*. 2000; Park *et al*. 2011), and in Australia particularly (Kowanko 1999; Schaller and James 2005; Arrish *et al*. 2014), nurses lack nutrition knowledge. This has been largely attributed to inadequate training at the undergraduate level, as well as limited continuing education (CE) opportunities to address this deficit (Lindseth 1990, 1994; Arrish *et al*. 2014). There is therefore an increased interest in educating nurses about nutrition to improve patient outcomes (Touger-Decker *et al*. 2001; Pradignac *et al*. 2011; Buxton and Davies 2013).

In order to maintain professional registration, nurses are required to undertake CE in many countries including Australia (Australian Health Practitioner Regulation Agency 2009), UK (Nursing & Midwifery Council 2017) and the USA based on state of registration (American Association of Colleges of Nursing 2010). Evidence suggests that CE programs, which are based on active learning such as those models utilising case studies, clinical simulations and participatory discussion, are

more effective than traditional didactic models of learning (Bluestone *et al*. 2013). It has been suggested that a blend of online and face-to-face education, which includes supervised clinical experiences, is optimal for nurse education (National Council of State Boards of Nursing 2015). The aim of this systematic literature review was to determine whether nutrition education for nurses results in improved knowledge and practices in delivering nutrition advice and programs to patients. Furthermore, it aims to unpack which models of CE for nutrition may be most acceptable and effective in practice.

Methods

A literature search was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al*. 2009; Fig. 1) in April 2015 using Scopus and Web of Science. The following terms were used in various combinations to perform searches: Practicing Nurse (Nurse, Midwife, Student); Continuing Education (education, program); Nutrition (healthy eating); Knowledge; Evaluation (Pre-test; post-test; before and after; effect); see Box 1 for an example search. Outcome measures that encompassed changes in either perceived or actual knowledge as determined by pre- and post-test surveys were included. Only articles published in peer-reviewed journals and reported in English were included. Eligible studies were those with practicing nurses or midwives undertaking a nutrition CE program that assessed their knowledge pre-test and post-test. Publications before 2000 were excluded from the review, as current education technologies would not have been available. Other exclusions applied were articles where the content of the CE program could not transcend to nurses providing patient education on nutrition (such as parental or enteral feeding), and articles that did not report knowledge outcome results specific to nurses. Additional articles were retrieved through citation searches.

The initial search retrieved 203 articles after duplicates were removed. Articles were removed according to title ($n = 84$) and abstracts ($n = 119$), based on the inclusion and exclusion criteria. Full-text articles were assessed for eligibility ($n = 26$), 12 of which were included for the final review.

Data extraction was completed by the lead author and reviewed by the second author. Endnote X4 (Clarivate Analytics, Philadelphia, PA, USA) was used to manage the citations. An evaluation of quality of each article was completed using the National Health and Medical Research Council (NHMRC) levels of evidence recommendations (National Health and Medical Research Council 2009). A narrative synthesis of the studies was completed because of the heterogeneity in reporting outcomes of the studies.

Results

All 12 articles were quasi-experimental pre- and post-test in design and deemed to be low quality (Level IV) (National Health and Medical Research Council 2009). The sample size of nurses included in the studies ranged from 8 to 364; the median

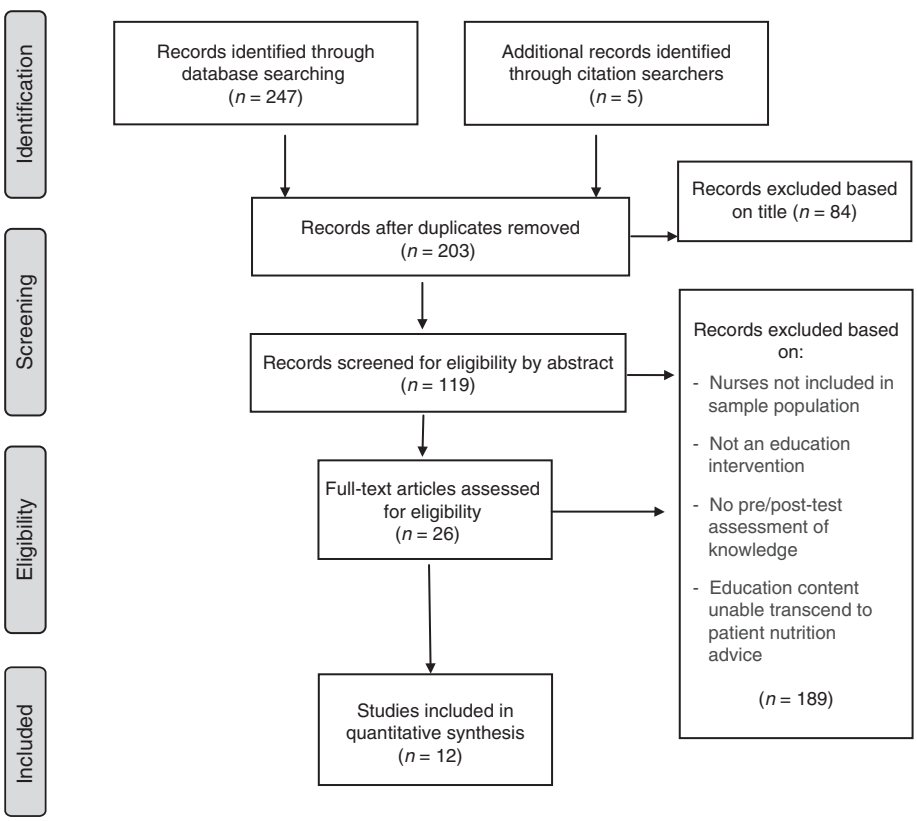

Fig. 1. PRISMA flow diagram for inclusion of journal articles in the systematic literature review.

Box 1. Example search strategy for reviewing models of nutrition continuing education programs for nurses

An asterisk indicates multiple word endings captured in the search; for example, educate and education

1. 'nurse' or 'midwife' or 'student'
2. 'education*' or 'program'
3. 'nutrition' or 'healthy eating'
4. knowledge
5. 'pre-test' or 'post-test' or 'before and after' or 'effect'
6. Points 1 and 2 and 3 and 4 and 5
7. Limit Point 5 to English language, human studies and reviews and articles

number of participants across the studies was 25 (Table 1). Studies were conducted in a range of countries: Australia (Manafi *et al*. 2008; Williams *et al*. 2013), Canada (Mayer *et al*. 2005), Spain (Arroyo *et al*. 2008), UK (Barrowclough and Ford 2001; Kennelly *et al*. 2010; Basu *et al*. 2014), USA (Crogan and Evans 2001; Bell *et al*. 2006; Wallner *et al*. 2007; Bernaix *et al*. 2008; Pregler *et al*. 2009) as well as in a range of healthcare settings: aged care (Crogan and Evans 2001; Arroyo *et al*. 2008), community (Pregler *et al*. 2009; Basu *et al*. 2014), hospital (Barrowclough and Ford 2001; Mayer *et al*. 2005; Bernaix *et al*. 2008; Manafi *et al*. 2008; Williams *et al*. 2013) and primary care (Kennelly *et al*. 2010). Two studies did not specify nurse practice settings (Bell *et al*. 2006; Wallner *et al*. 2007).

The effectiveness of nutrition CE models in improving nurses' nutrition knowledge was explored in terms of the mode of delivery, duration of the intervention and the educational strategies employed.

Mode of delivery

Eight studies (Crogan and Evans 2001; Arroyo *et al*. 2008; Bernaix *et al*. 2008; Manafi *et al*. 2008; Pregler *et al*. 2009; Kennelly *et al*. 2010; Williams *et al*. 2013; Basu *et al*. 2014) delivered a nutrition CE program to nurses utilising face-to-face learning. Of these, six studies (Arroyo *et al*. 2008; Bernaix *et al*. 2008; Manafi *et al*. 2008; Pregler *et al*. 2009; Kennelly *et al*. 2010; Basu *et al*. 2014) observed improvements in nurses' nutrition knowledge from pre-test to post-test.

Two studies (Barrowclough and Ford 2001; Mayer *et al*. 2005) successfully distributed self-directed learning packs to nurses and reported improvements in nutrition knowledge. Barrowclough and Ford (2001) provided an open-learning pack on general and pregnancy nutrition that consisted of a nutrition education resource pack, an audiocassette and printed material including interactive exercises, and found a significant increase in midwives' knowledge. Mayer *et al*. (2005) demonstrated similar improvements following a self-directed learning pack, which included independent activities designed to encourage critical thinking and reflection through experiential learning.

The review also included two studies (Bell *et al*. 2006; Wallner *et al*. 2007) that utilised an online platform to deliver their CE program to nurses. Wallner *et al*. (2007) demonstrated that an online course with six web-based modules on food safety increased a small sample of nurses' nutrition knowledge. Conversely, Bell *et al*. (2006) failed to demonstrate improvements in nurses' knowledge of type 1 diabetes dietary management after completing a web-based module, which formed part of a larger online course.

Intervention duration

Across studies that implemented face-to-face programs, the duration of intervention ranged from 20 min to 6 h, with two studies (Arroyo *et al*. 2008; Williams *et al*. 2013) delivering multiple education sessions over a specified time period. Of the two studies that provided self-directed learning packs to nurses, neither quantified the time participants spent with the nutrition education material. Additionally, only one study (Wallner *et al*. 2007) that delivered an online program reported the average time nurses spent on the model, which was measured at 48.2 min.

Educational strategies

Four studies (Barrowclough and Ford 2001; Crogan and Evans 2001; Mayer *et al*. 2005; Arroyo *et al*. 2008) successfully implemented a nutrition CE program grounded in pedagogical theory, using active learning strategies. Arroyo *et al*. (2008) demonstrated cooperative learning strategies such as small group discussions, case studies, games and simulations, significantly increased nurses' knowledge of general and geriatric nutrition. Although not reported to be guided by theory, four other studies (Wallner *et al*. 2007; Bernaix *et al*. 2008; Kennelly *et al*. 2010; Basu *et al*. 2014) utilised similar active learning strategies and demonstrated improvements in nurses' nutrition knowledge. For example, Basu *et al*. (2014) incorporated group discussions, activities using food models, and worksheets to facilitate midwives' achievement of learning outcomes in nutrition, physical activity and weight management advice during pregnancy. Conversely, a large study by Pregler *et al*. (2009) revealed a passive learning style lecture on cardiovascular disease prevention in women improved nurses' knowledge score for three nutrition-related questions.

Discussion

This systematic literature review identified that nutrition CE programs delivered face-to-face or by self-directed learning packs, and those that use active learning strategies, are associated with improvements in nurses' nutrition knowledge. However, the review did not provide sufficient evidence to support this association in the context of online learning. Further, there was inconsistent evidence to indicate a clear association between the duration of nutrition CE programs and the extent of improvements in levels of nutrition knowledge. It is noteworthy that positive associations were demonstrated between implementation of nutrition training programs and improved knowledge of nurses in all but three of the studies.

The positive associations observed with face-to-face education programs suggest that when education material is communicated in the presence of both teacher and learner, improvements in nurses' nutrition knowledge are observed. It has been asserted that face-to-face learning fosters non-verbal cues to convey both overt and unspoken meaning, which may contribute to the learning process (Buckley 2003). However, with current advances in technology, there is much debate in the literature between the efficacies of face-to-face learning, in comparison to online learning (Campbell *et al*. 2008; Bloomfield

Table 1. Summary of articles included in the systematic literature review

Note: all studies had a pre-and post-test design and used a convenience sample. Results are reported as pre-test *v.* post-test. NHMRC, National Health and Medical Research Council; CI, confidence interval; NICU, Neonatal Intensive Care Unit; GP, General Practitioner; MCQ, Multiple Choice Questionnaire; MUST, Malnutrition Universal Screening Tool; CVD, cardiovascular disease; ANOVA, analysis of variance; HSD, honestly significant difference

Reference	Sample size and population	Intervention	Outcome measure	Main findings
Arroyo *et al*. 2008	$n = 16$ nurses + $n = 28$ nursing assistants, Spain	Twelve 75-min face-to-face education sessions over three consecutive weeks. Cooperative learning strategies utilised including small group discussions, case studies, games and simulations	88-item general nutrition MCQ and 18-item geriatric MCQ	Increase in total general nutrition knowledge (difference between pre- and post-test mean score: 14.52 ± 10.11; $P < 0.001$). Increase in total geriatric nutrition knowledge (difference between pre- and post-test mean score: 4.61 ± 4.64; $P < 0.001$).
Basu *et al*. 2014	$n = 32$ community midwives, UK	One 3.5-h face-to-face education session. Strategies included group discussions, short lectures, activities, worksheets and client–midwife video simulations	6-item self-reported knowledge and an eight-item self-reported confidence questionnaire	89% indicated 'better' knowledge of obesity-related risks in pregnancy (95% CI: 73–97). 97% indicated 'better' knowledge of pregnancy-specific food and nutrition messages (95% CI: 85 to 100). 80% indicated 'better' knowledge of pregnancy vitamins (95% CI: 63 to 92). 91% indicated 'better' knowledge of pregnancy weight gain recommendations (95% CI: 77 to 98).
Bernaix *et al*. 2008	$n = 64$ NICU nurses, USA	One 4-h face-to-face education session using a lecture and discussion format	24-item Nurse Lactation Survey (NLS) presented in a forced-choice (true/false/unsure) format	Significant increase in mean NLS knowledge scores at post-test (difference in mean score: 5.26; $P < 0.001$) and 2 weeks post-test (difference in mean score: 4.48; $P < 0.001$). Decrease in NLS knowledge scores from post-test to 3-month post-test (difference in mean score: –3.79; $P < 0.001$).
Crogan and Evans 2001	$n = 8$ nurses, USA	One 6-h face-to-face education session using interactive experiential learning	15-item nutrition knowledge MCQ	Mean per cent knowledge score improved (56 ± 14.6 *v.* 66 ± 15); however, not significant ($P = 0.136$).
Kennelly *et al*. 2010	$n = 9$ practice nurses + 20 nursing home nurses + 53 community nurses + 14 GPs, Ireland	One 1-h or three 1-h face-to-face session(s) incorporating case studies and group work	8-item nutrition knowledge MCQ	Significant increase in all nurses' knowledge from pre-test (4.1 ± 1.6) to post-test (6.8 ± 1.2) and 6-months post-test (6.2 ± 1.3) ($P < 0.05$). Significant decrease in knowledge scores from post-test to 6-month post-test (6.8 ± 1.2 *v.* 6.2 ± 1.3; $P < 0.05$).

Manafi *et al*. 2008	*n* = 23 registered nurses, Australia	One 30-min face-to-face lecture	15-item renal nutrition knowledge MCQ	Significant increase in knowledge in paired samples (7.7 ± 2.2 *v*. 9.0 ± 1.7; *P* = 0.004).
Pregler *et al*. 2009	*n* = 1285 health professionals (*n* = 364 registered nurses), USA	One 1-h face-to-face lecture	Eight-item knowledge MCQ on risk stratification, lifestyle modification, pharmacotherapy and cultural awareness; two-item self-assessment of knowledge questionnaire	Significant increase in knowledge of: primary dietary source of trans-unsaturated fatty acids (58.0 *v*. 88.5; *P* < 0.001). Significant increase in self-assessment of knowledge in: current approaches to smoking cessation, exercise, weight management and diet to reduce risk for CVD in women (3.2 ± 0.9 *v*. 3.7 ± 0.8; *P* < 0.001); and goals for major risk factor interventions to prevent CVD in women (3.0 ± 0.9 *v*. 3.5 ± 0.9; *P* < 0.001).
Williams *et al*. 2013	*n* = 23 paediatric nurses, Australia	Five 20 to 30-min face-to-face education sessions	19-item general breastfeeding knowledge questionnaire using a five-point Likert scale; 10-item breastfeeding knowledge relevant to the hospitalised infant questionnaire using a four- and five-point Likert scale	Significant increase in knowledge in 6/19 general breastfeeding knowledge areas, including baby-led feeding (65.2 *v*. 82.6; *P* = 0.01) and need for other food in the first 6 months (52.1 *v*. 69.6; *P* = 0.01).
Barrowclough and Ford 2001	*n* = 27 midwives, UK	Open-learning pack (6 h completion times). The pack consisted of a nutrition education resource pack, an audiocassette and printed material including a variety of interactive exercises	General nutrition, pregnancy nutrition, food safety and constipation management structured questionnaire	Significant increase in mean nutrition scores (46.81 ± 14.59 *v*. 71.29 ± 13.04; *P* < 0.001). Significant decrease in the mean number of wrong answers (16.04 ± 3.98 *v*. 12.20 ± 5.73; *P* < 0.005).
Mayer *et al*. 2005	*n* = 23 nurses, Canada	The intervention utilised a self-directed learning manual based on adult learning theory and included activities to promote critical thinking and reflection, encouraged users to value and share experiential learning, and guided users to evaluate the success of counselling	10-item Health Promotion Counselling Self-Efficacy Scale questionnaire on self-confidence in knowledge of areas of risk reduction and ability to convey this knowledge to patients	Significant increase from pre-test, post-test and 2-month post-test scores for self-reported knowledge (2.61 ± 0.65 *v*. 3.24 ± 0.70 *v*. 3.48 ± 0.65; HSD = 0.29; α = 0.05) and counselling self-efficacy (2.50 ± 0.68 *v*. 3.14 ± 0.77 *v*. 3.37 ± 0.77; HSD = 0.32; α = 0.05).
Bell *et al*. 2006	*n* = 56 nurses, USA	15 module web-based education program	10-item questionnaire completed before and immediately following each module	Difference in pre/post-test knowledge scores was not significant (88.75 ± 9.92 *v*. 92.33 ± 9.55, *P* = 0.079).
Wallner *et al*. 2007	*n* = 106 healthcare professionals (*n* = 9 nurses), USA	Online education course with six web-based modules completed over 8 weeks. The modules were delivered in 50- to 60-min audio lectures, completed over 8 weeks	15-item knowledge MCQ	Total mean knowledge score for all modules increased significantly (0.71 *v*. 0.93; *P* < 0.001).

et al. 2010; Cook *et al*. 2010; McCutcheon *et al*. 2015), particularly with the context of CE and the need to balance professional commitments of nurses. In exploring this dichotomy, Buckley (2003) found no significant difference in undergraduate nurse outcomes when transitioning a traditional classroom-based nutrition course to a web-based course. Self-directed learning packs similarly offer nurses flexibility to fulfil their CE requirements in consideration of their professional commitments. This model is founded in the adult learning principles of autonomy and self-direction (Mayer *et al*. 2005); whereby students must assume responsibility and accountability of their learning in order to complete the training manual. Barrowclough and Ford (2001) and Mayer *et al*. (2005) demonstrated the effectiveness of self-directed learning packs to significantly improve nurses' nutrition knowledge.

The Australian Nursing and Midwifery Council defines CE as 'the means by which [nurses] maintain, improve and broaden their knowledge, expertise and competence … [through] … participating in relevant learning activities and reflecting on the value of those activities'(Australian Nursing and Midwifery Council 2009). This definition supports the development of CE programs based on active learning where students engage in the learning process, as opposed to passively receiving information in a traditional lecture setting (Bonwell and Eison 1991). As identified in this review, active learning strategies were positively associated with improvements in nurses' nutrition knowledge. It has been asserted that the development of context-dependent knowledge is crucial to the integration of theory and practice within the nursing profession (Tanner 2007). The importance of active learning in improving nurses professional practice and patient outcomes has been highlighted in other systematic reviews on nursing CE (Thomson-O'Brien *et al*. 2002; Bluestone *et al*. 2013).

Although the duration of CE programs to improve nurses' nutrition knowledge was explored among the studies, no clear association was determined. Further research is required to investigate the duration of a nutrition CE program required to produce sustainable improvements in nurses' knowledge, while considering their professional and personal commitments.

Assessing the effectiveness of nutrition CE programs is challenging because of the complexity of measuring changes in knowledge. Several interrelated factors have been identified to influence nutrition knowledge; including age, gender, level of education and socioeconomic status (Spronk *et al*. 2014). Some studies in this review (Barrowclough and Ford 2001; Mayer *et al*. 2005; Bernaix *et al*. 2008; Williams *et al*. 2013) did consider factors relevant to CE, such as nurses' area of practice, level of experience and previous involvement in nutrition and non-nutrition-related CE; however, no factor was universally accounted for across all studies.

Comparing changes in nurses' nutrition knowledge between the studies was also difficult because of the variation in instrument validity; with two studies failing to report any validation procedures (Barrowclough and Ford 2001; Bell *et al*. 2006). Three studies (Crogan and Evans 2001; Mayer *et al*. 2005; Williams *et al*. 2013) used previously validated instruments, either in the original or adapted form; however, Mayer *et al*. (2005) was the only study to conduct reliability testing of an existing instrument within the relevant sample population. Most studies reported to have conducted one or two instrument validation methods; primarily construct validity or pilot testing. It has been asserted that the best practice for nutrition knowledge measurement is based on psychometric criteria, which includes content validity, construct validity and reliability (Heaney *et al*. 2011). Of the studies presented, Bernaix *et al*. (2008) was the only study to employ this level of validation.

The limited number of published randomised controlled trials limits interpretation of the findings with regard to identifying the best model of a nutrition CE program for nurses. All studies are especially vulnerable to selection bias because of convenience sampling, as participating nurses may have had a greater interest in nutrition. The internal validity of the studies is also low because of the lack of control groups exposed to the same array of intervening variables. Two databases were searched in addition to hand searching articles from reference lists. Despite this, it is possible that more articles may have been sourced if a wider database search had been conducted. Furthermore, this review is limited in that it only focussed on changes in nursing knowledge, and did not assess whether this increased knowledge translated into changes in their clinical practice, or whether there were improvements in patient outcomes.

The limited evidence available suggests that nutrition CE does improve nurses' knowledge; however, there is an apparent lack of nutrition-focussed CE available for nurses. Dietitians and nurses should therefore work collaboratively to develop learning programs to address this gap (DiMaria-Ghalili *et al*. 2014). This would upskill nurses to provide and reinforce basic nutrition advice in line with their patients' needs, as well as enable nurses to recognise when referral to a dietitian for medical nutrition therapy is warranted. The new paradigm for health care is moving from multidisciplinary to interdisciplinary care and thus inter-professional learning is essential (DiMaria-Ghalili *et al*. 2014).

Conclusions

This review provides evidence that nutrition CE programs: (1) are delivered face-to-face or by self-directed learning manuals; and (2) utilise active learning strategies are positively associated with improvements in the nutrition knowledge of nurses. However, the quality of this evidence is limited, hence further robust research is required to test the legitimacy of these recommendations, in addition to assessing whether increases in knowledge results in changes to practice and patient outcomes. Given the time constraints of healthcare professionals in the workplace, research examining online and blended nutrition education models is warranted. The increasing expectation of nurses to provide nutrition information to patients requires effective and proven models of CE in order to equip nurses with evidence-based nutrition knowledge and skills to assist in addressing global health issues.

Conflicts of interest

The authors have no conflicts of interest to declare.

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