

Effect of a theory-driven educational intervention on the level of knowledge, attitudes, and assessment practices regarding breakthrough cancer pain (BTCP) management among medical nurses in Hong Kong

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ABSTRACT

Purpose: To examine the effect of an educational intervention intended to improve medical nurses' adherence to breakthrough cancer pain (BTCP) assessment practices and their level of knowledge, attitudes and perceived assessment practices regarding BTCP management.

Methods: Nurses working in a regional hospital were recruited to this quasi-experimental study. The intervention group received a 3-h educational workshop and one session of individual clinical instruction, whilst the control group did not receive any intervention. Chart audits were performed to examine adherence to BTCP assessment practices as the primary outcome. A self-developed questionnaire was used to measure nurses' knowledge, attitudes and perceived assessment practices regarding BTCP management as the secondary outcomes. The chi-square or Fisher's exact test was used to compare the rate of adherence to BTCP assessment practices between groups. A generalised estimating equation was used to compare changes in knowledge, attitudes, and perceived assessment practices between groups over time.

Results: One hundred and five nurses completed the study. The chart audits revealed a significantly higher rate of adherence to BTCP assessment practices in the intervention group after the intervention ($p < .05$). The intervention group exhibited significant positive changes in scores for knowledge ($\beta = 25.49$, $p < .001$), attitude ($\beta = 0.98$ to 2.81 , $p < .01$), and their perceived assessment practices ($\beta = 1.33$ to 3.14 , $p < .002$) when compared with the control group.

Conclusions: This theory-driven educational intervention significantly improved the medical nurses' adherence to BTCP assessment practices and their level of knowledge attitudes and perceived assessment practices regarding BTCP management.

1. Introduction

Cancer pain management is an essential part of the care of cancer patients and is of particular importance for patients with advanced-stage cancer. Indeed, the results of a systematic review indicated that 64% of patients with advanced cancer require pain management (van den Beuken-van Everdingen et al., 2007). Clinical practice guidelines have been established to guide assessments of cancer pain, and appropriate pain management is given to patients according to the assessed severity of pain (Fallon et al., 2018; World Health Organization [WHO], 2018). In accordance with these guidelines, the constant administration of appropriate analgesics generally enables background cancer pain to be

stabilised and controlled. However, patients may sometimes experience transient pain exacerbation, which is known as breakthrough cancer pain (BTCP).

BTCP may occur spontaneously or in response to a specific predictable or unpredictable trigger (Davies et al., 2009). It is very common; almost 75% of patients with advanced cancer experience significant episodic BTCP despite receiving an analgesic regimen that controls their background pain (Mercadante, 2015). Patients with BTCP experience profound adverse effects that often interfere with activities of daily living and thus reduce their quality of life and societal roles (Breivik et al., 2009; Davies et al., 2013; Webber et al., 2011). Moreover, these patients have a higher risk of anxiety and depression (Li et al., 2017),

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and their care places additional burden on medical resources (e.g., hospitalisation and emergency visits) (Abernethy et al., 2008; Fortner et al., 2002).

The diagnostic algorithm for BTCP assessment proposed by Davis et al. (2009) is used as a guide to identify patients with BTCP, who should then be treated with a rescue medicine, such as morphine (WHO, 2018), to minimise their pain. Even though such measures are available, BTCP remains under-treated (Deandrea et al., 2014), possibly due to insufficient knowledge regarding BTCP assessment and health professionals' attitudes towards the use of opioid analgesics (Salim et al., 2017). Reviews indicate that the main barriers faced by health professionals in providing effective cancer pain management to patients include insufficient education, negative beliefs about the adverse effects of opioids, inadequate pain assessment and poor adherence to documentation (Kwon, 2014; Salim et al., 2017). A survey conducted in European countries also revealed that oncology nurses encountered difficulties in assessing BTCP and that approximately 38% of them were unaware of the analgesics that could be prescribed for BTCP (Rustøen et al., 2013a). Moreover, approximately 34%–42% of these nurses stated that they refrained from advising patients to request strong painkillers because of their adverse effects and because the patients' pain was not always severe (Rustøen et al., 2013a).

It has been suggested that an effective educational strategy needs to be developed to train and improve health professionals' knowledge, attitudes and clinical practices regarding cancer pain management (Admass et al., 2020; Bernardi et al., 2007; Jho et al., 2014; Yildirim et al., 2008), as properly trained health professionals would be able to facilitate the delivery of cancer pain education to cancer patients who experience background pain and BTCP and thus improve the management of BTCP (Herrero et al., 2020; Lovell et al., 2014; Wilkes et al., 2003). An interventional study was conducted to examine the effects of cancer pain education delivered by trained nurses to patients with cancer pain recruited from both inpatient and outpatient settings (Koh et al., 2018). This intervention was found to significantly reduce the patients' overall pain intensity and improve their quality-of-life outcomes. Furthermore, the patients recruited from outpatient groups showed an increase in the use of short-acting analgesics for BTCP (Koh et al., 2018).

Nurses are key players in the identification, assessment and timely management of cancer pain, and it has been recommended that nurses who work with cancer patients receive further education and training on BTCP management (Porta-Sales et al., 2016). However, not all cancer patients admitted to hospital will be assigned to oncology or palliative care units, and some studies have found that 42%–60% of cancer patients are admitted to acute care settings and general medical wards (Mameli et al., 2018; Young et al., 2016). In Hong Kong, a local study revealed that 50% of patients with advanced cancer were admitted to non-palliative care settings, such as medical wards, during their last 6 months of life (Tse et al., 2007). Baek et al. (2016) found that 29% of cancer patients with moderate to severe background cancer pain who were admitted to a general ward reported experiencing BTCP. Omran et al. (2014) investigated the knowledge and attitudes about pain management held by oncology and non-oncology nurses and observed that the nurses' knowledge differed significantly in relation to the adequacy of their professional training (Omran et al., 2014). Lai et al. (2003) examined whether nurses in Taiwan were prepared to manage cancer pain, and whether their knowledge of pain management would differ depending on the ward setting. In that study, nurses working in oncology and emergency units exhibited a higher level of knowledge about pain management, compared with nurses in other settings (e.g., medical and surgical units) (Lai et al., 2003). Lui et al. (2008) revealed that nurses who worked in medical wards in Hong Kong had insufficient knowledge and inappropriate attitudes regarding cancer pain management, including BTCP management. In view of these, nurses must be equipped with better knowledge and skills to deliver the best pain-relief therapy to their cancer patients. In this context, adequate training of

nurses in the management of BTCP would enable them to assess patients correctly and deliver treatment more rapidly. Thus, an educational intervention for BTCP management among nurses working in medical wards is needed in the local context. The aim of this study was to develop an educational intervention for nurses in medical wards who care for patients with advanced cancer who experience BTCP, and to test whether this intervention can improve medical nurses' adherence to BTCP assessment practices and their level of knowledge, attitudes and perceived assessment practices regarding BTCP management.

2. Methods

2.1. Design

This quasi-experimental study with a non-equivalent group design was conducted in a regional acute-care hospital. Randomised and cluster-randomised controlled trial designs were considered infeasible because the nurses could not be blinded to their assigned groups within the same ward. It was also considered impractical to randomly assign the six medical wards involved in the study due to the wards' locations: two male medical wards were both located on one floor (13th floor), while two female medical wards were both located on another floor (11th floor). The participating nurses in the intervention wards attended an educational intervention that comprised a 3-h theory-driven educational workshop and a single session of individual clinical instruction, whereas the participants in the control wards did not receive this intervention.

2.2. Setting and participants

The study was conducted from February to July 2017 in the Medical and Geriatric (M&G) unit of an acute regional hospital in Hong Kong. This unit comprises six acute medical wards with 292 beds, including two male wards, two female wards and two mixed wards. Cancer patients who receive palliative care services are usually admitted to these medical wards after an emergency admission, so the nurses who work in these medical wards are responsible for their care. Eligible nurses who met the following inclusion criteria were recruited into the study: 1) had a registered or enrolled nursing certification for working in the M&G unit; 2) were working in as a nursing officer/advanced practice nurse/registered nurse/enrolled nurse; and 3) were providers of direct nursing palliative care. Nurses who served as ward managers, part-time staff and student nurses were excluded because they were not involved in the routine care of cancer patients.

2.3. Sample size

A similar study that aimed at improving nurses' pain knowledge, attitudes and pain assessment practices (Zhang et al., 2008) was used to guide the sample size planning. That study revealed that nurses who had undergone a pain educational programme, compared with a control group of nurses, showed improved pain knowledge and attitudes by an effect size of 2.4 and a net improvement of 54% in pain assessment practice (72% vs 18%) at the end of the 3-month study period. To allow a more conservative effect size of 0.8 to be detected in our study, it was estimated using GPower 3.1 that a sample size of 34 nurses per group would be adequate to detect an effect size of 0.8 on the nurses' knowledge and attitudes with 90% power at a two-sided significance level of 5%. Further allowing for an attrition rate of 20%, a requirement of 42 nurses was estimated in both the intervention and the control groups. Furthermore, to detect a net difference of at least 30% in the pain assessment practice between the intervention and control groups via patient chart review, it was estimated that at least 56 patient charts would be required in each of the intervention group and the control group to achieve 90% power at a two-sided significance level of 5%.

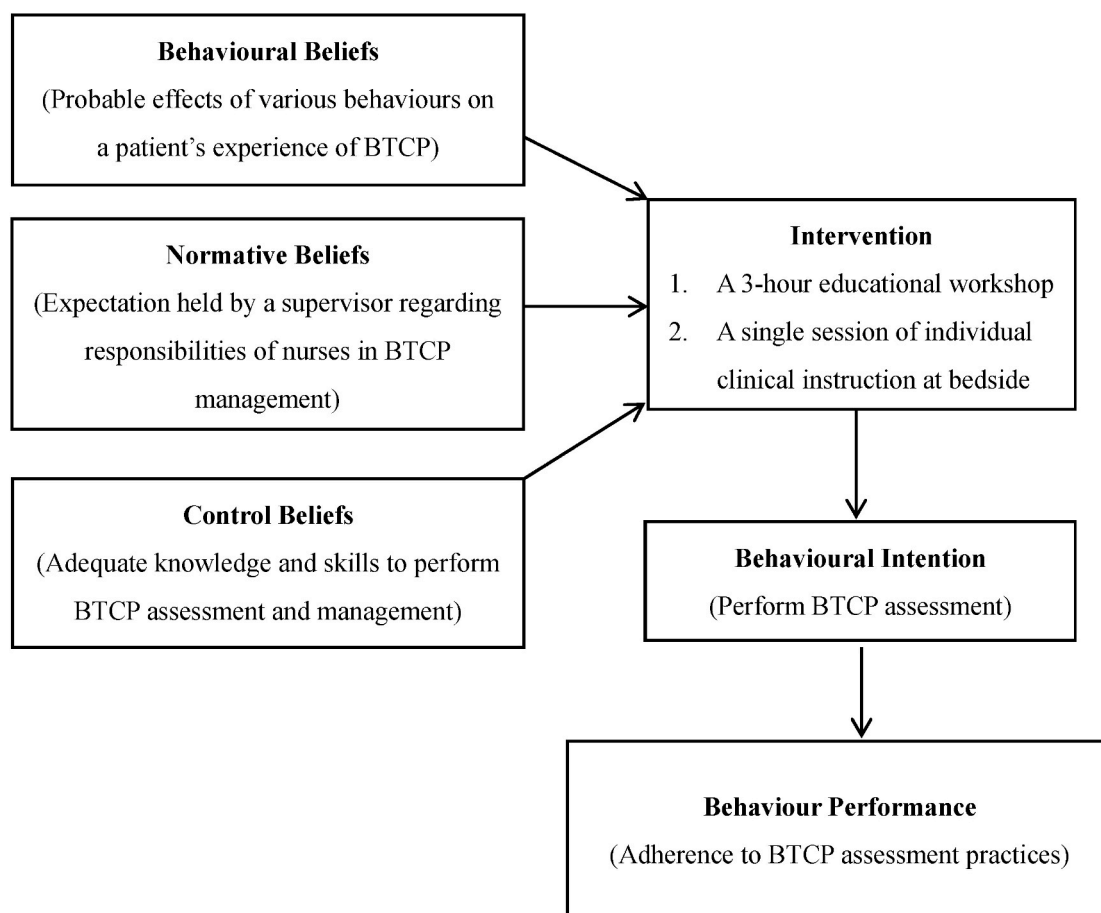


Fig. 1. The TPB model-guided BTCP educational intervention.

2.4. Procedure

2.4.1. Allocation

Four of the six participating medical wards were on opposite sides of the same floor, and the intervention and control wards were selected from different floors to decrease the likelihood of contamination (i.e., nurses from the two wards meeting to discuss the intervention or sharing intervention materials). The two male medical wards on the 13th floor and one mixed ward on the 12th floor were allocated to the intervention group, and the two female medical wards on the 11th floor and one mixed ward on the 2nd floor were allocated to the control group. In addition, the participating nurses were requested not to access the Internet during the study period to obtain information regarding BTCP management. The nurses in the intervention wards were also asked not to discuss or share information about BTCP management with the nurses in the control wards.

2.5. Intervention and control groups

2.5.1. Intervention development and implementation in the intervention group

A theory-driven educational intervention was developed based on the Theory of Planned Behaviour (TPB). The TPB holds that human behaviour is guided by “behavioural beliefs, normative beliefs and control beliefs” (Ajzen, 1991); behavioural beliefs produce a favourable or unfavourable attitude towards a behaviour, normative beliefs reflect an individual’s beliefs about others’ expectations regarding a particular behaviour, and control beliefs reflect an individual’s perceived control over and ability to display the behaviour.

The TPB model is commonly used in the health care field, and its use

has been shown to yield significant improvements in nurses’ knowledge and attitudes regarding cancer pain management and to successfully predict a nurse’s intent to conduct pain assessments (Godin et al., 2008; Nash et al., 1993). The intervention comprised the three components of the TPB, as follows: (1) a case scenario-based group discussion intended to increase the nurses’ positive beliefs regarding the likely effects of various behaviours on the experiences of patients with BTCP; (2) a speech delivered by the Department Operations Manager intended to improve the nurses’ beliefs regarding their normative expectations and how these expectations would increase the nurses’ adherence to correct BTCP assessment practices; and (3) the introduction of European Oncology Nursing Society (EONS) BTCP guidelines for BTCP management (Wengström et al., 2014a) and a discussion of myths and misconceptions related to opioid use, which were intended to improve the nurses’ beliefs regarding perceived control and confidence in their BTCP assessment and management skills. These three components of the TPB were integrated into the intervention, which comprised an educational workshop and individual clinical instruction intended to improve the nurses’ intention to perform BTCP assessment and their behavioural performance (i.e., actual adherence to assessment practices). Fig. 1 shows how the TPB model was used to guide the development of the educational intervention.

The educational materials used for the workshop comprised a pocket version of the 2013 EONS BTCP guidelines, a worksheet and a numerical rating scale (NRS) pain-assessment tool. The EONS guidelines for BTCP management contained a definition of BTCP, a classification of BTCP types, an algorithm for BTCP diagnosis, a BTCP assessment, a list of pharmacological and non-pharmacological interventions for BTCP and a reassessment of possible intervention outcomes. The educational strategies used were interactive lectures and group discussions aimed at

Table 1
Educational Contents and Teaching and Learning Strategies used During the 3-h Workshop.

Program Content	Teaching and learning strategies
Part 1 (5 minutes) Welcome and introduction.	
Part 2 (10 minutes) The Department Operations Manager (M&G Unit) was invited to deliver a speech about the goals of this education program and expectations of nurses' responsibilities for BTCP assessment and management after training.	
Part 3 (45 minutes) 1. Screening of a video of a patient's experience of BTCP. 2. Presentation of realistic patient scenarios and case sharing involving nurses' positive and negative attitudes regarding BTCP management. 3. Group discussion of the values and key roles of a nurse in the context of BTCP control.	1. Video screening 2. Experience and case sharing 3. Group discussion and reflection
Part 4 (60 minutes) Introduction of the BTCP guidelines. 1. EONS guidelines for BTCP assessment and management. - Definition of BTCP. - Classification of types of BTCP. - Algorithm for BTCP diagnosis. - Assessment of BTCP. - Management of BTCP. a) Pharmacological intervention. b) Non-pharmacological intervention. - Reassessment of BTCP. 2. Discussion of the myths and misconceptions related to opioid use.	1. Lecture 2. Viewing educational videotape 3. Provision of educational materials, including a pocket-size copy of EONS BTCP guidelines and numerical rating scale (NRS) pain assessment tool 4. Discussion
Part 5 (60 minutes) Demonstration and practice of exercises regarding BTCP assessment and documentation. 1. Demonstration of BTCP assessment and documentation. 2. Use of practice in case scenarios to reinforce nurses' assessment skills.	1. Role-playing 2. Hands-on practice with BTCP assessment and management.

improving the nurses' knowledge and attitudes regarding cancer-pain assessment and management (Dalton et al., 1996; Ferrell et al., 1993; Francke et al., 1997; Ger et al., 2004; Gustafsson and Borglin, 2013; Hauck, 1986; Howell et al., 2000; Patiraki et al., 2006). Practical exercises and distributed educational materials were also used to improve the nurses' skills and assessment practices (de Rond et al., 2000; Plymale et al., 2001; Vallerand et al., 2004; Zhang et al., 2008) (Table 1).

The number and duration of sessions and the implementation format were based on the results of a literature review, which reported that a 2- to 4-h theory-guided educational programme effectively improved nurses' knowledge and attitudes concerning cancer pain management (Gustafsson and Borglin, 2013; Hauck, 1986). It was also found that a single session of individual clinical instruction regarding the use of a pain-rating scale and documentation of a patient's pain effectively improved nurses' knowledge, attitudes and assessment practices with regard to cancer pain (Zhang et al., 2008). Thus, our educational intervention comprised a 3-h workshop that involved multiple educational strategies. After each workshop, one session of individual clinical instruction at patients' bedsides was arranged for each nurse. In this individual session, the nurses used the BTCP diagnostic algorithm and an NRS to assess patients and were supervised after the assessment while documenting the patients' pain intensity and BTCP management. In this study, the intervention was delivered solely by the principal

investigator, a qualified Advanced Practice Nurse specialised in palliative care, who ensured that the educational intervention was implemented as intended.

2.5.2. Control group

The nurse participants in the control wards did not receive any intervention.

2.5.3. Pilot test of the intervention

Sixteen participants (eight nurses from the intervention ward group and eight from the control ward group) were recruited to participate in a pilot test of the preliminary effects of the intervention. The completion rate for both groups was 100%. The results indicated that this intervention was feasible and acceptable and that it improved the medical nurses' knowledge regarding BTCP management, with an effect size of 0.58 (Kwok, 2018). The participants who took part in the pilot test also participated in the main study (Kwok, 2018).

2.6. Data collection

Ethical approval was obtained from the Kowloon West Cluster Research Ethics Committee [REC no. KW/FR-16-196(106-09)] and the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee (CREC no. 2016.576) in Hong Kong. Recruitment was solicited via public announcement and electronic mail to all eligible medical nurses. A public announcement was made by placing posters that briefly described the study on the notice boards of the medical wards. Additionally, lists of eligible nurses were obtained from the managers of the six medical wards. These nurses received the poster containing the brief study description via electronic mail. All sets of documents (an information sheet, a consent form, and an envelope) were distributed to interested eligible nurses in the wards by the principal investigator. Consenting participants in both groups were asked to complete questionnaires with items related to nurses' knowledge, attitudes and perceived assessment practices regarding BTCP management at baseline (T0) and 12 weeks after the educational intervention (T1). The participants were asked to return the completed questionnaires in the provided envelope. Chart audits of cancer patients receiving palliative care who were admitted to any of the six acute medical wards were performed 3 months before and after the educational intervention.

2.7. Outcome measures

The primary outcome of this study was the nurses' adherence to BTCP assessment practices, which was assessed through a chart audit. The secondary outcomes were the nurses' knowledge of and attitudes towards BTCP management and their perceived assessment practices, which were assessed using a self-reported questionnaire. It was anticipated that the nurses who received this theory-driven educational intervention would demonstrate improved knowledge and attitudes regarding BTCP management, resulting in positive change in behavioural performance in their clinical practice. The medical nurses' adherence to BTCP assessment practices was first evaluated using a chart audit, which enabled us to examine whether the educational intervention effected a behavioural change in their BTCP assessment practices. The chart audit included all advanced cancer patients receiving palliative care services who were admitted to any of the six acute medical wards. The audit criteria associated with the seven BTCP assessment practice items were based on local practice and international guidelines (Ripamonti et al., 2011; Swarm et al., 2010; Wengström et al., 2014a). The seven chart audit items were 1) routine pain assessment of cancer patients upon admission, 2) BTCP assessment of admitted cancer patients who presented with pain problems, 3) assessment of BTCP intensity using a validated pain-rating scale, 4) reassessment of the patients' pain intensity, 5) administration of breakthrough opioid analgesics, 6) documentation of the patients' pain intensity and 7)

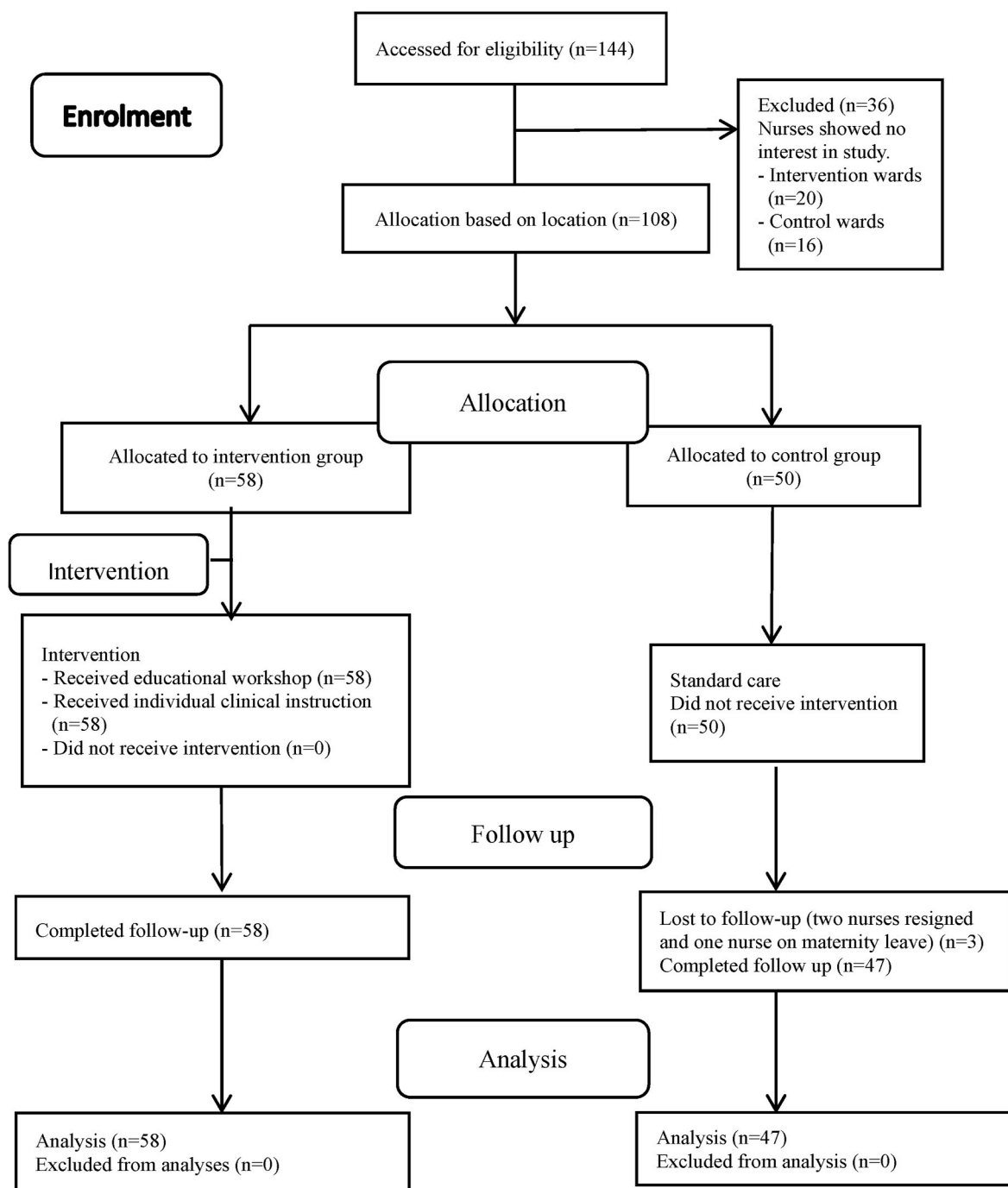


Fig. 2. Study flowchart.

documentation of the effects of BTCP management. The chart audits were conducted 3 months before and after the intervention. The charts of all nurses who attended the educational intervention were assessed by the principal investigator.

Although a Nurses' Knowledge and Attitude Survey (NKAS) was previously developed by Ferrell et al. (1993) to assess nurses' knowledge and attitudes towards pain, the items in this survey did not specifically focus on an assessment of BTCP knowledge or the nurses' attitudes towards BTCP management. Therefore, we needed to develop a questionnaire to assess the nurses' knowledge, attitudes and their perceived assessment practices targeting BTCP management in the local context to meet the aims of this study. The nurses' level of knowledge, attitudes and their perceived assessment practices regarding BTCP management

were evaluated using a self-reported questionnaire that was developed by a panel of eight clinical experts and academics, including a university nursing professor, palliative care specialists, nurse consultants from palliative care and pain specialties, an advanced practice nurse and a department operations manager from a medical specialty. After four rounds of revision, the questionnaire was finalised. It comprised three sections: knowledge (11 multiple-choice questions), attitudes (6 questions) and assessment practices (7 questions).

The knowledge questionnaire items were based on international BTCP guidelines with the intent to evaluate the essential concepts and aspects of BTCP, that is, the definition, features, effects, diagnosis, types and management of BTCP (Wengström et al., 2014a). The possible scores on the knowledge section of questionnaire ranged from 0 to 11, as

correct and incorrect answers were given scores of 1 and 0, respectively. Correct answers were summed to yield a total score and converted to a total aggregate score of 0–100 points (i.e., total knowledge). A score of less than 60 was considered to indicate insufficient knowledge of BTCP management.

The attitude items were based on international and local studies that sought to measure nurses' attitudes towards the prioritisation of BTCP management, opioid addiction, opioid-induced adverse effects, perceived effects of non-pharmacological management, awareness of pharmacological treatment and confidence regarding BTCP assessment and management (Lui et al., 2008; Rustøen et al., 2013b; Tse and Chan, 2004; Wengström et al., 2014b). The participants rated each statement in the attitude section on a scale of 1–10, with a higher score indicating more positive attitudes towards BTCP management.

The assessment practices items were based on the BTCP guidelines and were directed by unit policies aimed to measure the local (Hong Kong) practice of nurses during BTCP assessment and reassessment, the use of a validated pain-rating scale, documentation of the patients' pain intensity and the effects of BTCP management. In the assessment practices section, the participants rated each statement on a scale of 1–10, with a higher score indicating their greater perceived adherence to BTCP assessment practices.

The content validity indices for the items in all three domains ranged from 0.97 to 1.00 (Polit et al., 2007). A face validity test was performed with 12 nurses to probe the clarity and relevance of the questionnaire items. They reported that each item was clear and relevant and could be completed within 20 min. As the 10 essential aspects of BTCP-related knowledge are not interrelated and the level of BTCP knowledge may depend on the nurses' experience, the use of Cronbach's alpha to assess the reliability of the knowledge domain may not be relevant (Taber, 2018). Our questionnaire to test the reliability of nurses' attitudes and assessment practices regarding BTCP management demonstrated Cronbach's alpha values of 0.54 and 0.81 for the attitude and assessment practice domains, respectively.

2.8. Data analysis

Data were analysed using SPSS (version 22). Descriptive statistics and chi-square or Fisher's exact tests were used to determine differences in the baseline characteristics between the intervention and control groups. A chi-square or Fisher's exact test was used to compare the rates of adherence to BTCP assessment practices between the groups based on the results of a chart audit. An independent *t*-test and a generalised estimating equation (GEE) were used to compare changes in scores for the sections on nurses' knowledge, attitudes and their perceived assessment practices regarding BTCP management between groups over time and to statistically account for nurses who were lost to follow up.

3. Study results

3.1. Recruitment and completion

From 13 to February 28, 2017, 144 eligible nurses were identified, and 108 agreed to participate in the study (58 in the intervention group, and 50 in the control group). The study completion rate was 97% ($n = 105$); three participants were lost to follow-up due to resignation or maternity leave (Fig. 2).

3.2. Participant characteristics

Most of the 108 participants were female (77; 71%), were registered nurses (77; 71%) and had attained a Bachelor's degree or higher (76; 70%). More than half of the nurses (71; 66%) were younger than 30 years, and more than half (67; 62%) had 5 years of work experience or less. The two groups of nurses were comparable in terms of age, rank, education level, work experience and prior BTCP education, but not in

Table 2

Comparison of variables between the control and intervention groups at baseline.

General demographic information of the participants ($n = 108$)					
Demographic Characteristics	Control Group ($n = 50$)		Intervention Group ($n = 58$)		* <i>p</i> -value
	<i>n</i>	%	<i>n</i>	%	
Sex					
Male	3	(6)	28	(48)	* $< .001^b$
Female	47	(94)	30	(52)	
Age					
≤30 years	31	(62)	40	(69)	.63 ^a
31–45 years	19	(38)	18	(31)	
Rank					
Advanced Practice Nurse	9	(18)	12	(21)	.92 ^a
Registered Nurse	36	(72)	41	(71)	
Enrolled Nurse	5	(10)	5	(8)	
Highest level of education					
Diploma	18	(36)	14	(24)	.40 ^a
Bachelor	23	(46)	31	(54)	
Master	9	(18)	13	(22)	
Working experience					
<1 year	16	(32)	14	(24)	.07 ^b
1–5 years	15	(30)	22	(38)	
>5–10 years	4	(8.0)	13	(23)	
>10 years	15	(30)	9	(15)	

^a Chi-square test.

^b Fisher's exact test * $p < .05$.

terms of sex (47 females and 3 males in the control group, whereas 30 females and 28 males in the intervention group, $p < .001$) (Table 2).

3.3. Effects of the intervention on adherence to BTCP assessment practices: chart audit

All patients who were able to communicate, who were admitted to one of the six medical wards, and among them, those who fulfilled the audit criteria were included in the chart review. A total of 112 patient charts were included in the pre-intervention audit, and 133 patient charts were included in the post-intervention audit. The two groups did not differ significantly in the rates of BTCP assessment practices performed before the intervention. A significantly higher rate of adherence to BTCP assessment practices was observed in the intervention group after the intervention ($p < .05$), except for routine pain assessment upon patient admission and administration of breakthrough opioid analgesics (Table 3).

3.4. Effects of the intervention on nurses' knowledge

No statistically significant inter-group differences were found at baseline in knowledge (Table 4). At T1, the intervention group had a significantly higher total knowledge mean score than the control group ($p < .001$; Table 5). The GEE model revealed significant group-by-time interaction effects on nurses' scores at T1 for total knowledge regarding BTCP management [$\beta = 25.49$; 95% confidence interval (CI), 17.49 to 33.49; $p < .001$]. The total knowledge score in the intervention group improved from 53 ± 20.6 at baseline to 82 ± 15.3 at 12 weeks post-intervention, compared with 51 ± 19.8 at baseline and 55 ± 20.5 at 12 weeks post-intervention in the control group. Specifically, at T1, the nurses in the intervention group had significantly higher knowledge scores regarding the types of non-volitional and volitional incident pain, non-volitional BTCP management, the differentiation of background pain from breakthrough pain and nursing interventions for BTCP management than those in the control group ($p < .05$; Table 6).

Table 3

Results of a Comparison of Documentation Rates Regarding BTCP Assessment Practices between Nurses in Intervention Wards and those in Control Wards at Baseline (T0) and 12 Weeks after Intervention (T1).

BTCP assessment practice items	Chart audit criteria	Intervention wards		Control wards			Intervention wards		Control wards		
		At baseline (T0)		At baseline (T0)			At 12 weeks (T1)		At 12 weeks (T1)		
		Total		Total			Total		Total		
		n	n,%	n	n,%		p-value	n	n,%	n	
1. Routine pain assessment of the cancer patient upon admission.	1) Cancer patient receiving palliative care 2) Completed admission form a) pain intensity (VRS from no pain to extreme pain) b) pain location when patient had pain	75	70 (93)	37	34 (91.9)	0.781 ^a	92	84 (91.3)	41	39 (95.1)	441 ^a
2. BTCP assessment of admitted patients presenting with a pain problems.	1) Cancer patient receiving palliative care 2) Patient had around-the-clock opioids for background pain	28	7 (25)	6	1 (16.7)	0.56 ^b	39	37 (94)	11	3 (27.3)	* ^{<.001^b}
3. Assessment of BTCP intensity using a validated pain rating scale.	1) Cancer patient receiving palliative care										
a) Numeric Rating Scale (NRS)	2) Patient had around-the-clock opioids for background pain	7	0 (0)	1	0 (0)	NA	37	32 (86.5)	3	3 (0)	*.006 ^b
b) Verbal Rating Scale (VRS)		7	4 (57)	1	0 (0)	0.500 ^b	37	5 (13.5)	3	3 (100)	*.006 ^b
4. Reassessment of patients' pain intensity.	1) Cancer patient receiving palliative care 2) Patient had around-the-clock opioids for background pain 3) Patient complained of pain on admission 4) Pain intensity was reassessed within 24 hours	19	6 (31.6)	2	1 (50)	0.567 ^b	23	22 (96.5)	71	1 (14.3)	*.001 ^b
5. Administration of breakthrough opioid analgesics.	1) Cancer patient receiving palliative care 2) Opioids for breakthrough pain as needed (PRN) were prescribed by physicians	24	11 (45.8)	8	3 (37.5)	0.504 ^b	40	22 (55)	17	7 (41.2)	340 ^a
6. Documentation of patients' pain intensity.	1) Cancer patient receiving palliative care 2) Opioids for breakthrough pain as needed (PRN) were prescribed by physicians 3) Documented patient's pain intensity before opioids PRN and/or non-pharmacological interventions 4) Patient had severe pain or NRS ≥7	11	1 (9.1)	3	0 (0)	0.786 ^b	22	18 (81.8)	7	0 (0)	* ^{<.001^b}
7. Documentation of the effect of BTCP management.	1) Cancer patient receiving palliative care 2) Patient received PRN opioids and/or non-pharmacological intervention for breakthrough pain 3) Documented the effect 1 hour after opioid PRN and/or non-pharmacological interventions 4) Patient reported pain relief or mild pain or NRS ≤3	11	2 (18.2)	3	0 (0)	0.604 ^b	22	18 (81.8)	7	0 (0)	* ^{<.001^b}

^a Chi-square test.

^b Fisher's exact test. NA, no statistics were computed because the practice was consistent; VRS, Verbal Rating Scale; NRS, Numeric Rating Scale. * *p* < .05.

3.5. Effects of the intervention on nurses' attitudes

No statistically significant inter-group differences in attitude were found at baseline (Table 4). At T1, the intervention group had significantly higher scores on all attitude items, except the perceived effect of non-pharmacological intervention, than the control group ($\beta = 0.49$; $p = .062$). The GEE model revealed that at T1, there were significant group-by-time interaction effects on nurses' attitudes regarding the prioritisation of patient care for BTCP ($\beta = 0.98$; 95% CI, 0.23 to 1.73; $p < .01$), addiction to opioid analgesics ($\beta = 1.81$; 95% CI, 0.81 to 2.81; $p < .001$), opioid-induced over-sedation and respiratory depression ($\beta = 1.63$; 95% CI, 0.58 to 2.68; $p < .002$), awareness of BTCP treatment availability ($\beta = 1.76$; 95% CI, 0.90 to 2.63; $p < .001$) and confidence in BTCP assessment and management ($\beta = 2.81$; 95% CI, 1.99 to 3.63; $p < .001$; Table 5).

3.6. Effects of the intervention on nurses' perceived assessment practices

No statistically significant inter-group differences were found at

baseline, except for one practice item regarding the documentation of BTCP intensity (Table 4). At T1, the intervention group had significantly higher scores than the control group on all assessment practice items ($p < .05$). The GEE model revealed significant group-by-time interaction effects on the nurses' perceived assessment practice at T1 regarding routine pain assessment for cancer patients upon admission ($\beta = 2.02$; 95% CI, 1.07 to 2.97; $p < .001$), BTCP assessment of admitted cancer patients with pain problems ($\beta = 1.35$; 95% CI, 0.44 to 2.23; $p < .002$), assessment of BTCP intensity using a validated pain-rating scale ($\beta = 2.28$; 95% CI, 1.28 to 3.27; $p < .001$), administration of breakthrough opioid analgesics ($\beta = 1.33$; 95% CI, 0.49 to 2.16; $p < .001$), reassessment of patients' pain intensity ($\beta = 1.90$; 95% CI, 1.11 to 2.69; $p < .001$), documentation of BTCP intensity ($\beta = 3.14$; 95% CI, 2.19 to 4.07; $p < .001$) and documentation of the effects of BTCP management ($\beta = 3.06$; 95% CI, 2.21 to 3.92; $p < .001$; Table 5).

4. Discussion

The findings demonstrate that a theory-driven intervention using

Table 4

Nurses' scores on items of knowledge, attitudes, and assessment practices regarding BTCP management at baseline (T0).

Outcome Variables	Control Group	Intervention Group	p-value
	(n=50)	(n=58)	
	Mean (SD)	Mean (SD)	
Total knowledge scores (Maximum score: 100)	51.04 (19.8)	53.33 (20.06)	.560
Attitude items (6 statements)^a			
1. Patient care priority for BTCP.*	8.00 (1.74)	8.47 (1.59)	.107
2. Opioid analgesics addiction.	6.66 (2.39)	6.84 (2.66)	.786
3. Opioid induced over-sedation and respiratory depression.*	6.30 (2.37)	6.90 (2.37)	.293
4. Perceived effect of non-pharmacological intervention.*	6.94 (2.16)	6.83 (2.08)	.950
5. Awareness of BTCP treatment availability.	6.72 (1.98)	6.57 (2.02)	.796
6. Confidence in BTCP assessment and management.	4.80 (2.05)	4.66 (2.23)	.723
Assessment practice items (7 statements)^b			
1. Routine pain assessment for the cancer patients upon admission.	6.32 (2.17)	5.74(2.54)	.166
2. BTCP assessment of admitted cancer patients presenting with a pain problem.	5.34 (2.16)	5.79(2.25)	.275
3. Assessment of BTCP intensity using a validated pain rating scale.	5.78 (2.35)	6.02(2.56)	.644
4. Reassessment of patients' pain intensity.	6.86 (1.79)	6.66(2.19)	.600
5 Administration of breakthrough opioid analgesics.	7.46 (1.88)	7.29(2.08)	.509
6. Documentation of patient's BTCP intensity.	5.02 (2.19)	3.88(2.35)	*.007
7. Documentation of the effect of BTCP management.	4.46 (1.87)	4.00(2.33)	.205

^a A higher score (range: 1–10) indicates more positive attitudes towards BTCP management. Remark: starred items are "reverse scored".

^b A higher score (range: 1–10) indicates a greater adherence to BTCP assessment. SD, Standard deviation; P values were estimated using an independent t-test.

* $p < .05$.

multiple teaching and learning educational strategies yielded clinically and statistically significant improvements in the actual adherence to BTCP assessment practices, nurses' level of total knowledge, attitudes and their perceived assessment practices regarding BTCP management 12 weeks after the intervention among nurses who work in medical units.

In this study, a questionnaire for assessing nurses' knowledge, attitude and assessment practices regarding BTCP management was developed by a panel of clinical experts and university academics. High content validity index scores were obtained for this instrument, which indicated the relevance of the concept being measured and the appropriateness of the scale items for reflecting the construct of interest in the local population and setting (Polit et al., 2007). The results of the face validity test supported the clarity and relevance of the questionnaire items. According to Hinton et al. (2004), Cronbach's alpha values of 0.5–0.7 indicate moderate reliability, and values of 0.7–0.9 indicate a high degree of reliability. Moss et al. (1998) reported that a Cronbach's alpha value of greater than 0.6 indicates acceptable reliability. A lower Cronbach's alpha value was obtained for the attitude domain (0.54), possibly due to the short scales and diverse constructs (Taber, 2018). More items could be added to the attitude domain to improve the alpha value in the future study. In addition to internal consistency, test-retest reliability and factor analysis should be used to assess the validity and reliability of the revised attitude domain.

The two groups in this study shared similar demographic

characteristics except for the sex distribution, and this difference was attributable to the allocation of female and/or male nurses working in the two female medical wards to the control group and those working in the two male medical wards to the study group. Accordingly, a gender-adjusted GEE model was used to address the limitation of the adopted study design and to evaluate the outcomes of the intervention.

Nurses usually exhibited lower levels of confidence regarding BTCP assessment and management, likely due to a lack of knowledge. Nurses in countries with appropriate training have reported higher levels of confidence in BTCP management (Wengström et al., 2014b). Our study provides further evidence that educational intervention can lead to significant improvement in nurses' confidence regarding BTCP assessment and management. Furthermore, the pre-intervention chart audit showed no documentation of non-pharmacological nursing interventions for BTCP management, which may be attributable to time constraints and heavy workloads in an acute ward setting. The post-intervention chart audits show that 27% of patients ($n = 6$) in intervention wards received simple non-pharmacological nursing interventions such as positioning, which suggests that the intervention had improved the nurses' adherence to assessment practices and BTCP management.

Our chart audits demonstrated higher rates of adherence to all BTCP assessment practices items (>80%) in the intervention group than in the control group, except for the administration of breakthrough opioid analgesics. The intervention group's lower adherence rate to the administration of breakthrough opioid analgesics may be attributable to the small number of patients ($n = 40$) who fulfilled the audit criteria for inclusion in the post-intervention chart-audit period. However, the intervention group still exhibited a higher practice score and a 50% higher breakthrough opioid administration rate than the control group. This result revealed that training and education in BTCP management improved nurses' confidence and ability in assessing, identifying, and managing patients with BTCP. This result echoed a previous observation by Wengström et al. (2014b), who found that nurses who had received training expressed a higher perceived ability to assess and distinguish between breakthrough and background pain. Additionally, the trained nurses perceived fewer difficulties with BTCP management (Wengström et al., 2014b).

Before the intervention, the nurses in the medical wards used only the 5-point verbal rating scale to assess the BTCP intensity of patients, as minimal training is required to use a verbal rating scale. A NRS pain-assessment tool is considered a more reliable measure of cancer pain exacerbation and appears to be useful in clinical practice (Brunelli et al., 2010). Before the intervention, all nurses used the verbal rating scale to assess patients' BTCP intensity, but after the intervention, most nurses (86.5%) used the NRS to assess the patients' peak pain intensity. As suggested by a previous study, nurses may find it beneficial to use the NRS, which can accurately assess and reflect the pain intensity experienced by the patients, rather than the VRS rating, which includes a report of pain intensity and its interference with the patients' daily lives (Thong et al., 2018).

As all nurses are required to conduct and document general pain assessments in the admission charts of patients admitted to the study hospital's medical unit, no significant inter-group difference was expected. Indeed, both groups exhibited a pain assessment adherence rate of greater than 90% for cancer patients upon admission, suggesting good compliance with hospital policy. However, both groups received lower scores for assessment practices at baseline, as confirmed by the pre-intervention chart audit. Despite the small subgroup of nurses in the intervention group, the post-intervention chart audit showed that the nurses in this group had a significantly higher rate of adherence to assessment practices than the nurses in the control group which was reflected by the documentation of the practices in the charts. This result is similar to the improved reassessment and documentation of pain management activity reported in a United States setting, where the cumulative recorded documentation compliance rate reached 94.9%

Table 5

Results of the Independent t-Test and Gender-adjusted GEE Model of the Nurses' Knowledge, Attitude, and Assessment Practice Scores Regarding BTCP Management at 12 Weeks (T1).

Outcomes	Control group		Intervention group		Group × T1B (95% CI)	p-value [Between- group (group)]	p-value [Within- group (Time)]	p-value [interaction effect]
	T0	T1	T0	T1				
	(baseline)	(at 12 weeks)	(baseline)	(at 12 weeks)				
	n = 50	n = 47	n = 58	n = 58				
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)				
Total knowledge scores (Full mark: 100)	51.04 (19.8)	55.20 (20.57)	53.33 (20.06)	82.90 (15.3)	25.49 (17.49–33.49)	*0.001	0.174	* < .001
Attitude items (6 statements)^a								
1. Patient care priority for BTCP*	8.00 (1.74)	7.91 (1.83)	8.47 (1.59)	9.36 (0.83)	0.98 (0.23–1.73)	0.296	0.788	* < .010
2. Opioid analgesics addiction	6.66 (2.39)	6.85 (2.28)	6.84 (2.66)	8.84 (1.42)	1.81 (0.81–2.81)	*0.018	0.637	* .001
3. Opioid induced over- sedation and respiratory depression*	6.30 (2.37)	6.55 (2.36)	6.90 (2.37)	8.79 (1.35)	1.63 (0.58–2.68)	0.186	0.529	*.002
4. Perceived effect of non- pharmacological intervention*	6.94 (2.16)	7.45 (1.78)	6.83 (2.08)	7.84 (1.81)	0.49 (–0.37–1.35)	0.215	0.106	.262
5. Awareness of BTCP treatment availability	6.72 (1.98)	6.64 (1.69)	6.57 (2.02)	8.24 (1.29)	1.76 (0.90–2.63)	*0.006	0.791	*.001
6. Confidence in BTCP assessment and management	4.80 (2.05)	5.28 (1.78)	4.66 (2.23)	7.93 (1.22)	2.81 (1.99–3.63)	* < 0.001	0.12	* < .001
Assessment practice items (7 statements)^b								
1. Routine pain assessment for the cancer patients upon admission	6.32 (2.17)	6.89 (1.74)	5.74 (2.54)	8.33 (1.08)	2.02 (1.07–2.97)	*0.002	0.122	* < .001
2. BTCP assessment for admitted cancer patients presenting with a pain problems	5.34 (2.16)	6.49 (1.78)	5.79 (2.25)	8.29 (1.16)	1.35 (0.44–2.23)	0.168	*0.001	*.002
3. Assessment of BTCP intensity using a validated pain rating scale	5.78 (2.35)	6.32 (2.07)	6.02 (2.56)	8.83 (0.96)	2.28 (1.28–3.27)	*0.010	0.144	* < .001
4. Reassessment of patients' pain intensity	6.86 (1.79)	6.85 (1.55)	6.66 (2.19)	8.53 (0.94)	1.33 (0.49–2.16)	*0.039	0.655	*.001
5. Administration of breakthrough opioid analgesics	7.46 (1.88)	7.61 (1.58)	7.29 (2.08)	8.78 (1.05)	3.14 (2.19–4.07)	* < 0.001	* < 0.001	* < .001
6. Documentation of patients' BTCP intensity	5.02 (2.19)	6.40 (1.75)	3.88 (2.35)	8.40 (0.99)	1.90 (1.11–2.69)	* < 0.002	< 0.943	*.003
7. Documentation of the effect of BTCP management	4.46 (1.87)	5.77 (1.67)	4.00 (2.33)	8.36 (1.00)	3.06 (2.21–3.92)	* < 0.001	* < 0.001	* < .001

^aA higher score (range: 1–10) indicates a more positive attitude toward BTCP management. Starred items are reverse scored.^bA higher score (range: 1–10) indicates a greater perceived adherence to BTCP assessment practices.

SD, Standard deviation; The model estimates of regression coefficients for the time points and group interaction terms are shown.

(Gordon et al., 2008).

At baseline, both groups of nurses exhibited insufficient knowledge; in particular, many nurses had difficulty in distinguishing breakthrough pain from background pain and in identifying the types of BTCP, which was consistent with the findings of previous studies of hospice and oncology nurses (Rustøen et al., 2013b; Soden et al., 2010). Most of these nurses also lacked the knowledge needed to identify types of BTCP that may require a specific type of BTCP management (Rustøen et al., 2013b; Soden et al., 2010). A common example is the sub-classification of breakthrough pain as either spontaneous-type or incident-type breakthrough pain (Mercadante and Portenoy, 2016). With adequate knowledge about all types of BTCP, nurses can proactively identify and manage incident-type pain by administration of rescue opioid analgesics long before the patient undergoes certain procedures (Mercadante and Portenoy, 2016). For example, a nurse could administer breakthrough morphine syrup 30 min before a patient's scheduled walking exercise or

a scheduled dressing to prevent the occurrence of a BTCP episode.

Nurses' attitudes have been considered to be among the major barriers to providing effective cancer pain management (Kwon, 2014). Hong Kong nurses displayed negative attitudes towards opioid addiction and concerns about the adverse effects associated with opioids (Lui et al., 2008; Tse and Chan, 2004), consistent with a previous study and review of the fair and negative attitudes held by oncology nurses regarding cancer pain management (Bernardi et al., 2007; Bouya et al., 2019). The nurses' inadequate attitudes towards the use of opioids may inhibit their motivation to administer opioid analgesics to cancer patients with breakthrough pain and hinder effective BTCP management. This educational intervention comprised a discussion that targeted the myths and misconceptions related to opioid use. With the provision of sufficient education, it was expected that positive changes would occur in the nurses' beliefs and attitudes towards the use of opioids for BTCP management. The study results reveal a significant improvement in the

Table 6

Percentages of nurses with correct responses to knowledge items and a gender-adjusted GEE model comparison between the two groups at 12 Weeks (T1).

Knowledge item	Control Group		Intervention Group		Group (reference group: Control) × time OR (95% CI)	p-value [Between-group (group)]	p-value [Within-group (Time)]	p-value [Interaction effect]
	T0 (baseline) n = 50	T1 (at 12 weeks) n = 47	T0 (baseline) n = 58	T1 (at 12 weeks) n = 58				
1. Definition of BTCP	64%	81%	72%	90%	1.43 (0.43–4.79)	0.698	*0.041	.559
2. Features of spontaneous BTCP	34%	53%	40%	74%	2.07 (0.73–5.87)	0.389	*0.022	.173
3. Impacts of BTCP	86%	87%	86%	95%	2.67 (0.48–14.96)	0.614	0.862	.265
4. Types of non-volitional incident pain	54%	60%	28%	81%	9.15 (3.05–27.45)	*<0.001	0.549	*<.001
5. Non-volitional BTCP management	42%	57%	47%	93%	8.23 (2.19–30.87)	*0.039	0.057	*.002
6. Types of volitional incident pain	28%	40%	40%	86%	5.52 (1.70–17.89)	0.185	0.179	*.004
7. Ideal BTCP treatment	40%	30%	29%	36%	2.20 (0.73–6.63)	0.064	0.282	.161
8. Differentiate background pain from breakthrough pain	42%	30%	43%	90%	18.91 (6.13–58.37)	*<0.001	0.185	*<.001
9. Poorly controlled background pain management	56%	53%	85%	95%	3.76 (0.99–14.31)	0.762	0.766	.052
10. Nursing intervention for BTCP management	66%	53%	66%	90%	8.23 (2.46–27.54)	*0.007	0.167	*.001
11. Nursing management of procedural pain	50%	62%	52%	81%	2.48 (0.94–6.56)	0.453	0.091	.068

Model estimates of odds ratios (OR) and 95% confidence intervals (CI) for the time points and group interaction terms are shown. * $p < .05$.

medical unit nurses' attitudes towards opioid analgesic addiction and opioid-induced over-sedation and respiratory depression. Furthermore, the in-service pain management education programme for nurses was deemed useful in terms of improving their attitudes towards pain management, consistent with the findings of a previous study (Germossa et al., 2018).

4.1. Implication for practice and future research

This study provides evidence that a theory-driven intervention and multiple educational strategies can effectively improve nurses' adherence to BTCP assessment practices, their level of total knowledge, attitudes and their perceived assessment practices regarding BTCP management. BTCP is a prevalent and often severe type of pain. Patients may experience incident-type or spontaneous-type BTCP and will thus require proper assessment and individualised treatment. Frequent contact with patients allows nurses to conduct continuous assessments and provide timely pain management. Therefore, it is critical to equip nurses with sufficient knowledge to distinguish between the various types of BTCP, hold informed attitudes regarding the use of opioid rescue medication and exhibit appropriate assessment and management practices. We therefore recommend that nursing education for cancer pain management should include a component that focuses on BTCP assessment and management, and that additional training in this area must be provided to nurses who care for cancer patients. In addition, hospitals could include this 3-h educational intervention as a routine in-service training programme for nurses. The content of the educational intervention should cover the existing guidelines for BTCP management, assessment and relevant pharmacological and non-pharmacological interventions. As an accurate assessment of the pain intensity experienced by patients could assist nurses with decisions regarding the administration of pain medication, the educational intervention should cover a BTCP assessment and, particularly, instructions on the use of an NRS. To facilitate the intervention content delivery, various educational strategies, including interactive lectures, group discussions and sharing by patients, role-playing and hands-on practice with BTCP assessment and management, should be adopted to enhance the information delivery and capture the required skills in BTCP assessment and management.

It is recommended that future studies can use a multi-centre design and evaluate changes in nursing practices over a longer period. In addition, patients' outcomes in terms of pain experience and quality of life should also be measured to reveal the multifaceted efficacy of this intervention.

4.2. Strengths and limitations

This study has certain strengths and limitations to be acknowledged. The strengths of the educational intervention were that it was theory-driven and that the content and the educational strategies were evidenced-based. The high recruitment and retention rates support the feasibility and acceptability of this educational intervention among nurses.

The study had several limitations. First, this single-centre study adopted a convenience-sampling method, which may limit the generalisability of the results. Second, the attitude domain in the questionnaire was found to have lower Cronbach's alpha values, as we developed the nurses' knowledge, attitudes and assessment practices regarding BTCP management questionnaire to meet the aims of this study. A lower Cronbach's alpha value may be due to the short scale and diversity of the items covered in the attitude domain. In a future study, more items could be added to the domain to improve the alpha value. In addition to the internal consistency, the test-retest reliability and a factor analysis should be used to further evaluate the validity and reliability of the revised attitude domain. These analyses could provide more information to confirm the validity of the domain. Third, only a small number of patients fulfilled the audit criteria and were included in the chart audit during the study period, so only a small sub-group of nurses' assessment practices could be assessed. Fourth, baseline (T0) and follow-up (T1) measurements were conducted within a short period (3 months), which was insufficient to provide information about the long-term effects of the programme on the nurses' BTCP assessment practices. Fifth, a randomised controlled trial or cluster-randomised controlled trial design could not be adopted in this study because of the location of the study venue and concerns about contamination between the intervention and control groups. Sixth, the difference in the sex ratios between the nurses working in female and male wards in the

intervention and control groups also serves as a limitation, as it resulted in the allocation of a higher proportion of female nurses to the control group. Finally, patient-care outcomes were not measured because the aim of the study was to develop an educational intervention that specifically targets BTCP management and to measure the effects of this intervention on nurses' clinical behaviour. Further study is needed to investigate patient outcomes such as pain experience after the intervention.

5. Conclusions

BTCP has been recognised as a common problem that places multiple burdens on cancer patients and health care systems. This study provides evidence that a theory-driven intervention and multiple educational strategies can effectively improve nurses' adherence to BTCP assessment practices, their level of total knowledge, attitudes and perceived assessment practices regarding BTCP management at 12 weeks after the intervention. We therefore recommend that nursing education for cancer pain management must include a component regarding BTCP assessment and management and that additional training for BTCP assessment and management must be provided to nurses who care for cancer patients. In addition, this educational intervention could be included in hospitals as a routine in-service training programme for nurses.

Declaration of interest

None declared.

CRediT authorship contribution statement

Carman Y.L. Kwok: Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Data curation, Writing – original draft. **Dorothy N.S. Chan:** Validation, Writing – review & editing. **Winnie K.W. So:** Visualization, Supervision.

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References

- Abernethy, A.P., Wheeler, J.L., Fortner, B.V., 2008. A health economic model of breakthrough pain. *Am. J. Manag. Care* 14, S129–S140.
- Admass, B.A., Endalew, N.S., Tawuye, H.Y., Mersha, A.T., 2020. Knowledge and attitude of Ethiopian oncology nurses about cancer pain management: national survey. *Canc. Manag. Res.* 12, 9045–9055. <https://doi.org/10.2147/CMAR.S261172>.
- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50, 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T).
- Baek, S.K., Kim, D.Y., Kang, S.Y., Sym, S.J., Kim, Y.S., Lee, J.Y., 2016. A Korean nationwide survey for breakthrough cancer pain in an inpatient setting. *Canc. Res. Treat.* 48, 768–774. <https://doi.org/10.4143/crt.2015.087>.
- Bernardi, M., Catania, G., Lambert, A., Tridello, G., Luzzani, M., 2007. Knowledge and attitudes about cancer pain management: a national survey of Italian oncology nurses. *Eur. J. Oncol. Nurs.* 11, 272–279. <https://doi.org/10.1016/j.ejon.2006.09.003>.
- Bouya, S., Balouchi, A., Maleknejad, A., Koochakzai, M., Alkhasawneh, E., Abdollahimohammad, A., 2019. Cancer pain management among oncology nurses: knowledge, attitude, related factors, and clinical recommendations: a systematic review. *J. Canc. Educ.* 34, 839–846. <https://doi.org/10.1007/s13187-018-1433-6>.
- Breivik, H., Cherny, N., Collett, B., de Conno, F., Filbet, M., Foubert, A.J., Cohen, R., Dow, L., 2009. Cancer-related pain: a pan-European survey of prevalence, treatment, and patient attitudes. *Ann. Oncol.* 20, 1420–1433. <https://doi.org/10.1093/annonc/mdp001>.
- Brunelli, C., Zecca, E., Martini, C., Campa, T., Fagnoni, E., Bagnasco, M., Lanata, L., Caraceni, A., 2010. Comparison of numerical and verbal rating scales to measure pain exacerbations in patients with chronic cancer pain. *Health Qual. Life Outcome* 8, 42. <https://doi.org/10.1186/1477-7525-8-42>.
- Dalton, J.A., Blau, W., Carlson, J., Mann, J.D., Bernard, S., Toomey, T., Pierce, S., Germino, B., 1996. Changing the relationship among nurses' knowledge, self-reported behavior, and documented behavior in pain management: does education make a difference? *J. Pain Symptom Manag.* 12, 308–319. [https://doi.org/10.1016/S0885-3924\(96\)00183-2](https://doi.org/10.1016/S0885-3924(96)00183-2).
- Davies, A., Buchanan, A., Zeppetella, G., Porta-Sales, J., Likar, R., Weismayr, W., Slama, O., Korhonen, T., Filbet, M., Poulain, P., Mystakidou, K., Ardavanis, A., O'Brien, T., Wilkinson, P., Caraceni, A., Zucco, F., Zuurmond, W., Andersen, S., Damkier, A., Vejlgard, T., Nauck, F., Radbruch, L., Sjölund, K.-F., Stenberg, M., 2013. Breakthrough cancer pain: an observational study of 1000 European oncology patients. *J. Pain Symptom Manag.* 46, 619–628. <https://doi.org/10.1016/j.jpainsymman.2012.12.009>.
- Davies, A.N., Dickman, A., Reid, C., Stevens, A.-M., Zeppetella, G., 2009. The management of cancer-related breakthrough pain: recommendations of a task group of the Science Committee of the Association for Palliative Medicine of Great Britain and Ireland. *Eur. J. Pain* 13, 331–338. <https://doi.org/10.1016/j.ejpain.2008.06.014>.
- de Rond, M.E.J., de Wit, R., van Dam, F.S.A.M., van Campen, B.T.M., den Hartog, Y.M., Klievink, R.M.A., 2000. A pain monitoring program for nurses: effects on nurses' pain knowledge and attitude. *J. Pain Symptom Manag.* 19, 457–467. [https://doi.org/10.1016/S0885-3924\(00\)00128-7](https://doi.org/10.1016/S0885-3924(00)00128-7).
- Deandrea, S., Corli, O., Consonni, D., Villani, W., Greco, M.T., Apolone, G., 2014. Prevalence of breakthrough cancer pain: a systematic review and a pooled analysis of published literature. *J. Pain Symptom Manag.* 47, 57–76. <https://doi.org/10.1016/j.jpainsymman.2013.02.015>.
- Fallon, M., Giusti, R., Aielli, F., Hoskin, P., Rolke, R., Sharma, M., Ripamonti, C.I., 2018. ESMO guidelines committee. management of cancer pain in adult patients: ESMO clinical practice guidelines. *Ann. Oncol.* 29, iv166–iv191. <https://doi.org/10.1093/annonc/mdy152>.
- Ferrell, B.R., Grant, M., Jo Ritchey, K., Ropchan, R., Rivera, L.M., 1993. The pain resource nurse training program: a unique approach to pain management. *J. Pain Symptom Manag.* 8, 549–556. [https://doi.org/10.1016/0885-3924\(93\)90084-9](https://doi.org/10.1016/0885-3924(93)90084-9).
- Fortner, B.V., Okon, T.A., Portenoy, R.K., 2002. A survey of pain-related hospitalizations, emergency department visits, and physician office visits reported by cancer patients with and without history of breakthrough pain. *J. Pain* 3, 38–44. <https://doi.org/10.1054/jpai.2002.27136>.
- Francke, A.L., Luiken, J.B., de Schepper, A.M.E., Huijgen Abu-Saad, H., Grypdonck, M., 1997. Effects of a continuing education program on nurses' pain assessment practices. *J. Pain Symptom Manag.* 13, 90–97. [https://doi.org/10.1016/S0885-3924\(96\)00267-9](https://doi.org/10.1016/S0885-3924(96)00267-9).
- Ger, L.P., Chang, C.Y., Ho, S.T., Lee, M.C., Chiang, H.H., Chao, C.S., Lai, K.H., Huang, J. M., Wang, S.C., 2004. Effects of a continuing education program on nurses' practices of cancer pain assessment and their acceptance of patients' pain reports. *J. Pain Symptom Manag.* 27, 61–71. <https://doi.org/10.1016/j.jpainsymman.2003.05.006>.
- Germossa, G.N., Sjetne, I.S., Hellesø, R., 2018. The impact of an in-service educational program on nurses' knowledge and attitudes regarding pain management in an Ethiopian University Hospital. *Front. Publ. Health* 6, 229. <https://doi.org/10.3389/fpubh.2018.00229>.
- Godin, G., Bélanger-Gravel, A., Eccles, M., Grimshaw, J., 2008. Healthcare professionals' intentions and behaviours: a systematic review of studies based on social cognitive theories. *Implement. Sci.* 3, 36. <https://doi.org/10.1186/1748-5908-3-36>.
- Gordon, D.B., Rees, S.M., McCausland, M.R., Pellino, T.A., Sanford-Ring, S., Smith-Helmenstine, J., Danis, D.M., 2008. Improving reassessment and documentation of pain management. *Joint Comm. J. Qual. Patient Saf.* 34, 509–517. [https://doi.org/10.1016/s1553-7250\(08\)34065-3](https://doi.org/10.1016/s1553-7250(08)34065-3).
- Gustafsson, M., Borglin, G., 2013. Can a theory-based educational intervention change nurses' knowledge and attitudes concerning cancer pain management? A quasi-experimental design. *BMC Health Serv. Res.* 13, 328. <https://doi.org/10.1186/1472-6963-13-328>.
- Hauck, S.L., 1986. Pain: problem for the person with cancer. *Canc. Nurs.* 9, 66–76. <https://doi.org/10.1097/00002820-198604000-00003>.
- Herrero, C.C., Batista, N., Díaz Fernández, N., Escobar Álvarez, Y., Gonzalo Gómez, A., Isla Casado, D., Salud, A., Terrasa Pons, J., Guillem Porta, V., 2020. Breakthrough cancer pain: review and calls to action to improve its management. *Clin. Transl. Oncol.* 22, 1216–1226. <https://doi.org/10.1007/s12094-019-02268-8>.
- Hinton, P., Brownlow, C., McMurray, I., Cozens, B., 2004. *SPSS Explained*. Routledge, New York, NY.
- Howell, D., Butler, L., Vincent, L., Watt-Watson, J., Stearns, N., 2000. Influencing nurses' knowledge, attitudes, and practice in cancer pain management. *Canc. Nurs.* 23, 55–63. <https://doi.org/10.1097/00002820-200002000-00009>.
- Jho, H.J., Kim, Y., Kong, K.A., Kim, D.H., Choi, J.Y., Nam, E.J., Choi, J.Y., Koh, S., Hwang, K.O., Baek, S.K., Park, E.J., 2014. Knowledge, practices, and perceived barriers regarding cancer pain management among physicians and nurses in Korea: a nationwide multicenter survey. *PLoS One* 9, e105900. <https://doi.org/10.1371/journal.pone.0105900>.
- Koh, S.J., Keam, B., Hyun, M.K., Ju Seo, J., Uk Park, K., Oh, S.Y., Ahn, J., Lee, J.Y., Kim, J., 2018. Cancer pain management education rectifies patients' misconceptions of cancer pain, reduces pain, and improves quality of life. *Pain Med.* 19, 2546–2555. <https://doi.org/10.1093/pm/pny039>.
- Kwok, Y.L., 2018. *Effect of a Theory-Based Educational Intervention on Improving Level of Knowledge, Attitudes, and Assessment Practices Regarding Breakthrough Cancer Pain (BTCP) Management Among Medical Nurses: A Quasi-Experimental Study*. Doctoral Thesis. The Chinese University of Hong Kong.

- Kwon, J.H., 2014. Overcoming barriers in cancer pain management. *J. Clin. Oncol.* 32, 1727–1733. <https://doi.org/10.1200/jco.2013.52.4827>.
- Lai, Y.H., Chen, M.L., Tsai, L.Y., Lo, L.H., Wei, L.L., Hong, M.Y., Hsiu, L.N., Hsiao-Shen, S.T., Chen, S.C., Kao, C.C., Huang, T.W., Chang, S.C., Chen, L., Guo, S.L., 2003. Are nurses prepared to manage cancer pain? A national survey of nurses' knowledge about pain control in Taiwan. *J. Pain Symptom Manag.* 26, 1016–1025. [https://doi.org/10.1016/s0885-3924\(03\)00330-0](https://doi.org/10.1016/s0885-3924(03)00330-0).
- Li, X.M., Xiao, W.H., Yang, P., Zhao, H.X., 2017. Psychological distress and cancer pain: results from a controlled cross-sectional survey in China. *Sci. Rep.* 7, 39397. <https://doi.org/10.1038/srep39397>.
- Lovell, M.R., Luckett, T., Boyle, F.M., Phillips, J., Agar, M., Davidson, P.M., 2014. Patient education, coaching, and self-management for cancer pain. *J. Clin. Oncol.* 32, 1712–1720. <https://doi.org/10.1200/jco.2013.52.4850>.
- Lui, L.Y.Y., So, W.K.W., Fong, D.Y.T., 2008. Knowledge and attitudes regarding pain management among nurses in Hong Kong medical units. *J. Clin. Nurs.* 17, 2014–2021. <https://doi.org/10.1111/j.1365-2702.2007.02183.x>.
- Mameli, A., Cianchetti, E., Porru, M., Marongiu, F., 2018. Hospital admission of cancer patients: is always necessary care? *Ital. J. Med.* 12, 76. <https://doi.org/10.4081/ijm.2018.s2>.
- Mercadante, S., 2015. Breakthrough pain in cancer patients: prevalence, mechanisms and treatment options. *Curr. Opin. Anaesthesiol.* 28, 559–564. <https://doi.org/10.1097/aco.0000000000000224>.
- Mercadante, S., Portenoy, R.K., 2016. Breakthrough cancer pain: twenty-five years of study. *Pain* 157, 2657–2663. <https://doi.org/10.1097/j.pain.0000000000000721>.
- Moss, S., Prosser, H., Costello, H., Simpson, N., Patel, P., Rowe, S., Turner, S., Hatton, C., 1998. Reliability and validity of the PAS-ADD Checklist for detecting psychiatric disorders in adults with intellectual disability. *J. Intellect. Disabil. Res.* 42, 173–183. <https://doi.org/10.1046/j.1365-2788.1998.00116.x>.
- Nash, R., Edwards, H., Nebauer, M., 1993. Effect of attitudes, subjective norms and perceived control on nurses' intention to assess patients' pain. *J. Adv. Nurs.* 18, 941–947. <https://doi.org/10.1046/j.1365-2648.1993.18060941.x>.
- Omran, S., Al Qadiri, M., Ali, N.A., Al Hayek, M.F., 2014. Knowledge and attitudes about pain management: a comparison of oncology and non-oncology Jordanian nurses. *Nurs. Health* 2, 73–80. <https://doi.org/10.13189/nh.2014.020401>.
- Patiraki, E.I., Papanthanasoglou, E.D.E., Tafas, C., Akarepi, V., Katsaragakis, S.G., Kampitsi, A., Lemonidou, C., 2006. A randomized controlled trial of an educational intervention on Hellenic nursing staff's knowledge and attitudes on cancer pain management. *Eur. J. Oncol. Nurs.* 10, 337–352. <https://doi.org/10.1016/j.ejon.2005.07.006>.
- Plymale, M.A., Sloan, P.A., Johnson, M., Lafountain, P., Snapp, J., Vanderveer, B., Sloan, D.A., 2001. Cancer pain education: a structured clinical instruction module for hospice nurses. *Canc. Nurs.* 24, 424–429. <https://doi.org/10.1097/00002820-200112000-00002>.
- Polit, D.F., Beck, C.T., Owen, S.V., 2007. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res. Nurs. Health* 30, 459–467. <https://doi.org/10.1002/nur.20199>.
- Porta-Sales, J., Pérez, C., Escobar, Y., Martínez, V., 2016. Diagnosis and management of breakthrough cancer pain: have all the questions been resolved? A Delphi-based consensus assessment (DOIRON). *Clin. Transl. Oncol.* 18, 945–954. <https://doi.org/10.1007/s12094-015-1468-7>.
- Ripamonti, C.I., Bandieri, E., Roila, F., 2011. Management of cancer pain. *Ann. Oncol.* 22. <https://doi.org/10.1093/annonc/mdr390>.
- Rustøen, T., Geerling, J.I., Pappa, T., Rundström, C., Weisse, I., Williams, S.C., Zavrtnik, B., Kongsgaard, U.E., Wengström, Y., 2013a. A European survey of oncology nurse breakthrough cancer pain practices. *Eur. J. Oncol. Nurs.* 17, 95–100. <https://doi.org/10.1016/j.ejon.2012.05.005>.
- Rustøen, T., Geerling, J.I., Pappa, T., Rundström, C., Weisse, I., Williams, S.C., Zavrtnik, B., Wengström, Y., 2013b. How nurses assess breakthrough cancer pain, and the impact of this pain on patients' daily lives – results of a European survey. *Eur. J. Oncol. Nurs.* 17, 402–407. <https://doi.org/10.1016/j.ejon.2012.12.002>.
- Salim, N., Al Attyat, N., Tuffaha, M., Nigim, H.A., Brant, J., 2017. Knowledge and attitude of oncology nurses toward cancer pain management: a review. *Arch. Med.* 9. <https://doi.org/10.21767/1989-5216.1000210>.
- Soden, K., Ali, S., Alloway, L., Barclay, D., Perkins, P., Barker, S., 2010. How do nurses assess and manage breakthrough pain in specialist palliative care inpatient units? A multicentre study. *Palliat. Med.* 24, 294–298. <https://doi.org/10.1177/0269216309355918>.
- Swarm, R., Abernethy, A.P., Angheliescu, D.L., Benedetti, C., Blinderman, C.D., Boston, B., Cleeland, C., Coyle, N., deLeon-Casasola, O.A., Eilers, J.G., Ferrell, B., Janjan, N.A., Karver, S.B., Levy, M.H., Lynch, M., Moryl, N., Murphy, B.A., Nesbit, S. A., Oakes, L., Obbens, E.A., Paice, J.A., Rabow, M.W., Syrjala, K.L., Urba, S., Weinstein, S.M., 2010. Adult cancer pain. *JNCCN J. Natl. Compr. Canc. Netw.* 8, 1046. <https://doi.org/10.6004/jnccn.2010.0076>.
- Taber, K.S., 2018. The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Res. Sci. Educ.* 48, 1273. <https://doi.org/10.1007/s11165-016-9602-2>.
- Thong, I.S.K., Jensen, M.P., Miró, J., Tan, G., 2018. The validity of pain intensity measures: what do the NRS, VAS, VRS, and FPS-R measure? *Scand. J. Pain* 18, 99–107. <https://doi.org/10.1515/sjpain-2018-0012>.
- Tse, D.M.W., Chan, K.S., Lam, W.M., Leu, K., Lam, P.T., 2007. The impact of palliative care on cancer deaths in Hong Kong: a retrospective study of 494 cancer deaths. *Palliat. Med.* 21, 425–433. <https://doi.org/10.1177/0269216307079825>.
- Tse, M.M.Y., Chan, B.S.H., 2004. Knowledge and attitudes in pain management: Hong Kong nurses' perspective. *J. Pain Palliat. Care Pharmacother.* 18, 47–58. https://doi.org/10.1080/j354v18n01_04.
- Vallerand, A.H., Riley-Doucet, C., Hasenau, S.M., Templin, T., 2004. Improving cancer pain management by homecare nurses. *Oncol. Nurs. Forum* 31, 809–816. <https://doi.org/10.1188/04.onf.809-816>.
- van den Beuken-van Everdingen, M.H.J., de Rijke, J.M., Kessels, A.G., Schouten, H.C., van Kleef, M., Patijn, J., 2007. Prevalence of pain in patients with cancer: a systematic review of the past 40 years. *Ann. Oncol.* 18, 1437–1449. <https://doi.org/10.1093/annonc/mdm056>.
- Webber, K., Davies, A.N., Cowie, M.R., 2011. Breakthrough pain: a qualitative study involving patients with advanced cancer. *Support. Care Canc.* 19, 2041–2046. <https://doi.org/10.1007/s00520-010-1062-z>.
- Wengström, Y., Geerling, J., Rustøen, T., 2014a. European Oncology Nursing Society breakthrough cancer pain guidelines. *Eur. J. Oncol. Nurs.* 18, 127–131. <https://doi.org/10.1016/j.ejon.2013.11.009>.
- Wengström, Y., Rundström, C., Geerling, J., Pappa, T., Weisse, I., Williams, S.C., Zavrtnik, B., Rustøen, T., 2014b. The management of breakthrough cancer pain—educational needs a European nursing survey. *Eur. J. Canc. Care* 23, 121–128. <https://doi.org/10.1111/ecc.12118>.
- Wilkes, G., Lasch, K.E., Lee, J.C., Greenhill, A., Chiri, G., 2003. Evaluation of a cancer pain education module. *Oncol. Nurs. Forum* 30, 1037–1043. <https://doi.org/10.1188/03.onf.1037-1043>.
- World Health Organization, 2018. WHO Guidelines for the pharmacological and radiotherapeutic management of cancer pain in adults and adolescents. <https://apps.who.int/iris/bitstream/handle/10665/279700/9789241550390-eng.pdf?ua=1>. (Accessed 21 January 2021).
- Yildirim, Y.K., Cicek, F., Uyar, M., 2008. Knowledge and attitudes of Turkish oncology nurses about cancer pain management. *Pain Manag. Nurs.* 9, 17–25. <https://doi.org/10.1016/j.pmn.2007.09.002>.
- Young, A., Marshall, E., Krzyzanowska, M., Robinson, B., Brown, S., Collinson, F., Seligmann, J., Abbas, A., Rees, A., Swinson, D., Neville-Webbe, H., Selby, P., 2016. Responding to acute care needs of patients with cancer: recent trends across continents. *Oncol.* 21, 301–307. <https://doi.org/10.1634/theoncologist.2014-0341>.
- Zhang, C.H., Hsu, L., Zou, B.R., Li, J.F., Wang, H.Y., Huang, J., 2008. Effects of a pain education program on nurses' pain knowledge, attitudes and pain assessment practices in China. *J. Pain Symptom Manag.* 36, 616–627. <https://doi.org/10.1016/j.jpainsymman.2007.12.020>.