Relationship between nurses' pain knowledge and pain management outcomes for their postoperative cardiac patients

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Nurses' knowledge and perceived barriers related to pain management have been examined extensively. Nurses have evaluated their pain knowledge and management practices positively despite continuing evidence of inadequate pain management for patients. However, the relationship between nurses' stated knowledge and their pain management practices with their *assigned* surgical cardiac patients has not been reported. Therefore, nurses ($n = 94$) from four cardiovascular units in three university-affiliated hospitals were interviewed along with 225 of their assigned patients. Data from patients, collected on the third day following their initial, uncomplicated coronary artery bypass graft (CABG) surgery, were aggregated and linked with their assigned nurse to form 80 nurse–patient combinations. Nurses' knowledge scores were not significantly related to their patients' pain ratings or analgesia administered. Critical deficits in knowledge and misbeliefs about pain management were evident for all nurses. Patients reported moderate to severe pain but received only 47% of their prescribed analgesia. Patients' perceptions of their nurses as resources with their pain were not positive. Nurses' knowledge items explained 7% of variance in analgesia administered. Hospital sites varied significantly in analgesic practices and pain education for nurses. In summary, nurses' stated pain knowledge was

not associated with their assigned patients' pain ratings or the amount of analgesia they received.

Keywords: nurse pain knowledge, postoperative pain management outcomes, analgesia, cardiovascular patients

Introduction

Background

Effective postoperative pain management is problematic despite growing evidence of untoward consequences for recovery. Unrelieved pain from surgery can precipitate adverse responses, including pulmonary and cardiovascular dysfunction (Benedetti *et al.* 1984, O'Gara 1988, Dietrick-Gallagher *et al.* 1994, Watt-Watson & Stevens 1998) and may predispose a patient to long-term pain (Katz *et al.* 1996). Patients with greater pain after cardiovascular surgery also have had a higher incidence of atelectasis (Puntillo & Weiss 1994). This evidence has major implications for preventing postoperative complications.

Nurses have a major responsibility for assessing patients' acute pain and intervening with modalities such as opioids. Yet, surgical patients continue to report poorly controlled pain in spite of advances in pain research, education, and treatment options. For example, patients undergoing cardiovascular surgery have reported considerable unrelieved pain (Puntillo 1990, Puntillo & Weiss 1994, Valdix & Puntillo 1995). Moreover, they have received infrequent, inadequate analgesic doses or no opioid analgesia over the first three postoperative days (Maxam-Moore *et al.* 1994, Puntillo & Weiss 1994, Valdix & Puntillo 1995, Cecilia 2000). Nurses' documented lack of knowledge and their misbeliefs about pain may contribute to this problem (Watt-Watson 1987, Lander 1990, McCaffery *et al.* 1990, Hamilton & Edgar 1992, Lavies *et al.* 1992, Brunier *et al.* 1995, Clarke *et al.* 1996, Hancock 1996, Coyne *et al.* 1999). Therefore, the degree to which nurses' pain knowledge enables them to recognize and manage postoperative pain effectively is an important question. However, the impact of nurses' pain knowledge on pain management outcomes with their assigned postoperative cardiac patients is not known.

The degree to which nurses' pain-related practices reflect patients' needs may be influenced by nurses' characteristics such as their age, education, and birthplace, and/or the situational context such as hospital site (Gallop *et al.* 1989). Nurses with greater professional and continuing education were more knowledgeable about pain (Vortherms *et al.* 1992) and more comprehensive in their stated assessments of the patient's pain experience (Dalton 1989). Colleague support in different settings may vary, as nurses with greater knowledge and expertise have experienced conflict with both nursing and medical colleagues in attempting to improve pain management for their patients (Ferrell *et al.* 1993). As well, nurses' pain knowledge levels have varied with their cultural background (Brunier *et al.* 1995, McCaffery & Ferrell 1995).

Published measures of nurses' knowledge of pain have been focused primarily on analgesic management and/or side-effects such as addiction (Watt-Watson 1987, Kuhn *et al.* 1990, Lander 1990, McCaffery & Ferrell 1990, McCaffery *et al.* 1990, Hamilton & Edgar 1992, Lavies *et al.* 1992). Research to assess nurses' pain knowledge has not adequately addressed beliefs about patients' pain experience or contextual variables such as colleague support for analgesic decisions. Additional data are required to gain further insight into current pain practices and to determine the direction of future interventions.

Previously, paired caregiver-patient research has focused mainly on discrepancies in pain intensity ratings and demonstrated lower ratings from caregivers (Graffam 1981, Walkenstein 1982, Teske *et al.* 1983, Seers 1987, Sutherland *et al.* 1988, Van der Does 1989, Choiniere *et al.* 1990, Grossman *et al.* 1991, Zalon 1993, Cleeland *et al.* 1994). Nonpaired comparisons between clinicians and patients in the same institutional units have described caregiver knowledge gaps particularly related to opioids, inadequate pain relief for patients, and patients' expectations of pain and reluctance to take analgesia (Marks & Sachar 1973, Cohen 1980, Weis *et al.* 1983, Lavies *et al.* 1992, Drayer *et al.* 1999).

In summary, the degree to which pain knowledge influences pain outcomes such as pain and analgesic administration is unknown. Ward *et al.* (1998) emphasize the need to examine patient outcomes to determine whether initiatives such as education programmes change pain management practices. Nurses' pain knowledge and perceived competency have not been validated using pain management outcomes with their assigned patients. As part of a larger project (Watt-Watson *et al.* 2000), the purpose of this study was to examine the relationship between what nurses know and believe about pain and outcomes for their assigned postoperative cardiac patients related to pain and analgesic intake.

The study

Design and research questions

A descriptive, correlational, mixed between-within subjects design was used to examine the following research questions: (a) Do nurses with greater pain knowledge have patients who have pain management outcomes of less pain and more adequate analgesic use? and (b) Does nurses' knowledge vary with their age, education, and birthplace and/or hospital site?

Sample

Data were collected by the principal investigator from convenience samples of consenting patients and nurses in the four cardiovascular surgical units of three large metropolitan teaching hospitals over a 5-month period. Patients were interviewed on their third postoperative day following their first, uncomplicated coronary artery bypass graft (CABG) surgery. Fifteen (6%) of the 240 patients initially approached refused to participate because of fatigue or nausea ($n = 8$), participation in another study ($n = 1$), anger at the current medical care ($n = 1$), were not well enough ($n = 3$) to take part, or were not sufficiently fluent in English ($n = 2$). The 225 patient participants included 52 women and 173 men, of whom 62% were born in Canada and 88% spoke English at home. Women were significantly older than men, $X = 65 \pm 8{\cdot}7$ vs. $60 \pm 9{\cdot}0$ years; $t(223) = 3{\cdot}21$, $P < 0{\cdot}002$, and received fewer internal thoracic artery (ITA) grafts than men, $\chi^2(1) = 5{\cdot}77$, $P < 0{\cdot}02$. Significant site differences were not evident for patients' age, birthplace, pain location, number of bypasses received, or pain ratings.

Ten (9·6%) of the 104 nurses approached to participate refused or did not return the questionnaire, mainly because of current workload requirements. The 94 nurse participants included 86 women and eight men, the majority of whom were born in Canada (53%) and spoke English at home (82%). Nurses' ages, education level, birthplace, nursing experience, unit experience, and recent pain-related education are summarized in Table 1.

Table 1 Descriptive characteristics of the nurse sample

Characteristic	*n* (%)
Age ($X = 35 \pm 8{\cdot}7$) (years)	
22–29	32 (34)
30–39	39 (41)
40–49	13 (14)
50–55	10 (11)
Birthplace	
Canada	50 (53)
Philippines	18 (19)
West Indies/Trinidad/Jamaica	14 (15)
Europe/Australia/Hong Kong	7 (8)
Eastern Europe/South Asia	5 (5)
Nursing education	
RN diploma	82 (87)
Bachelor of Science in Nursing	10 (11)
RN and non-nursing baccalaureate	2 (2)
Nursing experience ($X = 10 \pm 8{\cdot}5$) (years)	
< 1–5	44 (47)
6–10	16 (17)
11–20	22 (23)
21–34	12 (13)
Unit experience ($X = 4 \pm 3{\cdot}9$) (years)	
< 1	7 (7)
1–5	72 (77)
6–10	8 (9)
11–20	7 (7)
Pain-related continuing education	
None	49 (52)
< 3 hours	30 (32)
Half day	8 (9)
Full day	3 (3)
Other	4 (4)

Measures

Patient instruments

Pain. The McGill Pain Questionnaire-Short Form (MPQ-SF) provides information about both the quality and intensity of pain within a limited time period and has established reliability and validity (Melzack 1987, Dudgeon *et al.* 1993). Pain quality is evaluated by 15 verbal descriptors, and pain intensity by the present pain intensity (PPI) and a visual analogue scale (VAS). For this study, several VAS pain intensity items extended the general VAS of the MPQ-SF, to ask about pain on movement over several time periods (see Table 2). VAS have been used to measure a variety of subjective phenomena including pain, and have demonstrated sensitivity and high reliability (Huskisson 1983). Multiple VASs may be used to increase reliability (Streiner & Norman 1996). The MPQ-SF was read to patients to facilitate accurate data collection and to increase the reliability of the findings.

Analgesic data

Analgesic prescription and administration data over the previous 24 hours were obtained from the chart on day three after surgery and converted to standardized parenteral morphine equivalents (Reisine & Pasternak 1996).

Table 2 Mean scores (SD) and percentage distribution of visual analogue pain scales (VAS)

VAS (0–100)	Mean (SD)	Mild 0–39 *n* (%)	Moderate 40–69 *n* (%)	Severe 70–100 *n* (%)
Most severe pain in last 24 hours	65 ± 25	31 (14)	65 (29)	129 (57)
Pain now when not moving	13 ± 18	196 (87)	25 (11)	4 (2)
Pain now when moving	50 ± 26	73 (33)	79 (35)	73 (33)
Most severe pain in last 3 hours	57 ± 25	51 (23)	74 (33)	100 (44)
Unpleasantness of last 3-hour pain	48 ± 30	75 (33)	78 (35)	72 (32)

Additional visual analogue scales

Patients self-administered three VAS to rate the degree to which their assigned nurse listened to them, understood, and helped with their pain, respectively (Watt-Watson *et al.* 2000). These VAS were summed for a total score (0–300) to determine the degree to which patients saw their nurse as a resource for their pain. A fourth VAS (0–100) asked patients how often they would ask the nurse voluntarily for medication for pain.

Nurse instruments

Pain knowledge. The Toronto Pain Management Inventory (TPMI) was developed for this study from previous research (Watt-Watson 1987) and includes 23 VAS, each rated on a scale of 0–100 (see Appendix A). Questions examined nurses' knowledge about pain management including analgesia, patients' experiences of and responses to pain, and professional issues such as nurses' perceived competence and colleague support. Items examined evidenced-based knowledge as well as common beliefs frequently accepted as fact without any scientific basis. The individual VAS scores were summed for a total score (0–2300) which was converted to a percentage. Possible values ranged from 0 (less knowledge) to 2300 or 100% (most knowledge). To avoid using negative items, as well as to decrease acquiescence bias, about half of the items were phrased so that higher scores indicate greater knowledge (i.e. items 4, 8, 11, 14, 15, 17, 19–23) (Streiner & Norman 1996). To generate the final score, the remaining items were reversed (i.e. subtracted from 100) and all 23 items are summed i.e. items 1–3, 5–7, 9, 10, 12, 13, 16, 18).

Face and content validity were established by nine nurse and four medical experts in surgical pain. As well, the measure was pretested for face and content validity and clinical utility with 37 graduating BScN students, including 14 diploma prepared nurses. Both groups were asked to evaluate statements for clarity, relevance to the surgical setting, and inclusiveness of content (Streiner & Norman 1996). Minimal changes involving clarity of wording in one item were required. As well, the measure was piloted over a 3-month period with 33 surgical nurses, and test–retest reliability was established over a 2-week period (ICC = 0·81).

Social desirability scale (SDS)

The SDS developed by Crowne & Marlowe (1960) has established reliability and validity (Crowne & Marlowe 1960, Holden & Fekken 1989). The SDS includes 33 true or false statements concerning personal attitudes and traits that focus on consideration of others. The internal consistency coefficient has been reported as 0·88. Discriminant validity was evident with the Edward Scale for abnormal psychological states ($P < 0{\cdot}05$) (Crowne & Marlowe 1960). This measure identifies those responses that focus on impressing the investigator rather than on the construct being tested and that consequently contribute to extraneous variance. Therefore, correlations between the SDS and the TPMI should not be significant if the substantive construct is being measured.

Procedure

Ethical approval was received from the university and the affiliated hospitals involved. After written consent was obtained, all participants were interviewed and given verbal instructions by the same researcher. Patients were interviewed from noon to the end of their assigned nurse's shift to match patient data with responses from the nurse assigned during this period.

The sample included 80 nurses who were assigned to 203 patients over the study period. Nurse measures were not independent for each patient because the same nurse was assigned to two or more patients in this sample. Therefore, data from multiple patients with the same nurse were aggregated to form 80 nurse–patient combinations for the TPMI analyses. On average, the nurse:patient ratio was 1:2·5. Scatter plots indicated that the aggregated total scores were normally distributed; the skews of distributions were minimal (0·04–0·38), excluding that for worst 24-hour pain, which was in the moderate range (–0·5). Norman and Streiner (1994) suggest that real vs. theoretical data show some degree of skew, and the negative skew for 24-hour pain was

anticipated from previous findings (Puntillo 1990, Puntillo & Weiss 1994, Valdix & Puntillo 1995). Sample size was adequate based on a power level of 0·8, an alpha of 0·05, and an effect size of 0·30 (Cohen 1988). This effect size was deemed to be acceptable because it was comparable to those used in other pain-related studies (Dahl *et al.* 1992, Todd 1996).

Statistical analyses

Descriptive statistics were tabulated and Pearson correlation coefficients, *t*-tests, and Chi-square were performed to evaluate associations within the primary and secondary research questions. Analysis of variance (ANOVA) was used to examine within group and between group differences for dependent interval variables of (a) pain intensity and analgesia and (b) nurses' knowledge and characteristics by nurses' birthplace and/or hospital site. For statistically significant ANOVAs, *post hoc* comparisons using Tukey's Honestly Significant Difference Test (HSD) (Norman & Streiner 1994) were applied to determine the source of the difference. The level of significance for all tests was 0·05.

Hierarchical multiple regression models were developed to explain variance in scores for (a) the previous 3-hour pain during the nurse–patient linked period and the amount of analgesics administered over the previous 24 hours and (b) pain knowledge. To minimize the number of variables, only those significantly related to the dependent variable ($P < 0{\cdot}05$) were entered into the regression equation. Dummy variables were created to indicate the categories of hospital site and birthplace, with the contrast category for hospital being site 1 and for birthplace, Canada.

Results

Nurses' pain knowledge and patients' pain ratings

Nurses' TPMI scores indicated moderate pain knowledge [$X = 68\%$ ($1565 \pm 151{\cdot}2$), scale range 0–2300], and ranged from 53% (1219) to 90% (2063). Moreover, the majority of nurses (53%) scored 69% or less, with only 15% scoring in the upper range of 75% or greater. Similar moderate scores have been documented previously (Watt-Watson 1987, Hamilton & Edgar 1992, Vortherms *et al.* 1992, Brunier *et al.* 1995, Clarke *et al.* 1996).

Most patients reported moderate to severe pain during the previous 24 hour (86%) and at the time of the interview when moving (68%) (see Table 2). As well, pain ratings for 3- and 24-hour worst pain correlated highly ($r = 0{\cdot}82$, $P < 0{\cdot}0001$). However, the mean total score for the MPQ-SF adjectives was not high [$X = 11{\cdot}8 \pm 7$ (scale range 0–45)], similar to other research (Valdix & Puntillo 1995).

Nurses with more pain knowledge did not have patients who experienced less pain during the previous 3-hour period of their assignment. Only weak trends were demonstrated between TPMI and (a) WORST 3-hour pain ($r = 0{\cdot}20$, $P < 0{\cdot}07$) and (b) pain NOW on movement ($r = 0{\cdot}21$, $P < 0{\cdot}06$). When hierarchical regression was used, TPMI scores did not explain any of the variance in the most severe 3-hour pain ratings. Although most nurses stated that they usually used a standard pain rating scale, 66% of their assigned patients did not remember their nurse's asking them a specific question to rate their pain in the previous 3 hours. The majority of patients rated their pain as severe before receiving the next analgesic dose, although over two-thirds of nurses stated the pain rating should be mild both after surgery and before the next analgesic dose.

To further understand the above results, differences between the upper third of nurses (TPMI $X = 75\%$) and lowest third ($X = 61\%$) were examined for individual TPMI items (see Table 3). Although significant differences were evident, all nurses expected that patients would voluntarily communicate their pain and ask for help. Both groups agreed that moderate pain was the norm after surgery. However, the upper third of nurses reported that about 20% of their postoperative patients had severe pain vs. the 40% reported by the lowest third. Almost a third of all nurses disagreed with their patients $\geq 25\%$ of the time, and 40% believed their patients overstated their pain $\geq 25\%$ of the time. Although nurses with the highest TPMI scores rated themselves as more knowledgeable and competent than did nurses in the lower group, means for both were high. Nurses in the upper third were perceived by patients as listening, understanding, and helping more than those in the lower group [t(d.f. 50) = 2·14], although scores for both were low. Patients did not perceive either group as helpful with pain management. No significant differences were evident between these two groups for nurse characteristics, including age and overall nursing or unit experience, or pain ratings.

Nurses' pain knowledge and analgesia

Undermedication of patients was evident from analgesic data, both in what was prescribed and administered (optimal standard dose: 50–60 mg SC morphine equivalents/24 hours). The average amount of analgesia *ordered* per 24 hours for patients was 33 ± 24 mg of morphine equivalents and ranged from 0 to 200 mg; two patients had no analgesic orders. Eighty per cent of patients had orders for less than 50 mg of morphine. The average analgesic order

Table 3 Differences in pain knowledge between nurses with high and low scores

	Pain knowledge scores		
	Lowest knowledge (≤1501, $n=30$)	Most knowledge (≥1640, $n=32$)	t(d.f. 60)
Toronto Pain Management Inventory Items (TPMI)			
Total TPMI score [*M* (%)]	1395 (61%)	1725 (75%)	16·13*
Items significant (%)			
Feel knowledge adequate	66	78	2·30**
Pain management competent	73	88	3·70*
Agree with patients	64	93	5·16*
Patients overstate pain	33	14	4·16*
Ask patient to wait for meds	45	20	4·73*
Expect patient to ask for meds	61	48	2·42**
Expect patient to tell if pain	58	47	2·25**
Ideal pain rating postop	22	11	2·90*
Pain rating before next dose	39	26	2·75*
Postop patients in severe pain	39	18	4·06*
Give opioids for chronic pain	49	73	3·87*
Ask for higher dose if pain continues	50	80	4·15*
Give morphine after surgery	46	82	4·94*
Decrease morphine if nauseated	34	15	3·02*
Items not significant (%)			
Patients addicted from opioids	12	9	NS
Difficulty changing orders	22	17	NS
Physicians support decisions	71	80	NS
Postop patients with mild pain	36	46	NS
Postop patients with moderate pain	58	55	NS
Give opioids orally if a choice	74	80	NS
Pain relief directly related to surgery	54	39	NS
Nurses support decisions	73	80	NS
Use of rating scale	70	64	NS

*$P < 0{\cdot}001$; **$P < 0{\cdot}05$.

was higher for women (39 mg) than for men (31 mg), t(d.f. 223) = 1·86, $P < 0{\cdot}06$.

The average amount of analgesia *administered* was 14 ± 9·6 mg, which was not related to gender. The amount administered ranged from 0 to 60 mg morphine equivalents. Most patients (80%) received 16 mg or less of analgesia over the previous 24 hours, which included part of their second postoperative day. On average, patients received 47% of the analgesics prescribed. Although 51% of patients rated their pain as severe before the next analgesic dose, 83% stated that they would not voluntarily ask for medication. Significant differences amongst hospital sites were evident both for analgesics prescribed ($F_{3221} = 12{\cdot}10$, $P < 0{\cdot}0001$) and those administered ($F_{3221} = 7{\cdot}36$, $P < 0{\cdot}0001$).

Nurses with more pain knowledge did not have patients who received more analgesia. However, nurses citing lower ideal pain ratings tended to have patients (a) who were more willing to tell them when a pain medication was needed ($r = -0{\cdot}32$, $P < 0{\cdot}003$) and (b) who had greater pain relief ($r = -0{\cdot}24$, $P < 0{\cdot}03$). Conversely, nurses with the least knowledge were associated with patients who had inadequate pain relief despite taking medications ($r = 0{\cdot}52$, $P < 0{\cdot}007$); the type, dose, and/or time interval of analgesic administration may have been inadequate for these patients. One-third of all nurses reduced the morphine dose with nausea ≥25% of the time and asked patients to wait for their medication 30% of the time. Although significant differences between the upper third of nurses (TPMI $X = 75\%$) and lowest third ($X = 61\%$) were evident related to opioid administration (see Table 3), addiction concerns still existed with both groups. Overall, 44% of nurses stated that 10% or greater of hospitalized patients become addicted. The final hierarchical regression model of the relationship between pain knowledge and analgesics administered included (a) analgesic orders, (b) hospital site, (c) most severe 24-hour pain, (d) TPMI: reduce opioid if patient nauseated, and (e) TPMI: patients overstate pain (see Table 4). Nurses' responses that postoperative patients with nausea should have their opioid reduced and that patients overstate their pain contributed 7% of the 39% of the variance explained.

Table 4 Hierarchical regression analysis for analgesics administered

Step	Variable added	R	R^2	β	F
1.	Analgesic orders	0·45	0·20	0·28	19·64*
2.	Hospital site	0·53	0·28	−0·02 (2v1) 0·12 (3v1) −0·19 (4v1)	7·17*
3.	Most severe pain in last 24 hours	0·57	0·32	0·22	6·97*
4.	Reduce opioid if patient nauseated (TPMI)**	0·60	0·36	0·21	6·72*
5.	Patients overstate pain (TPMI)**	0·62	0·39	−0·18	6·43*

*$P < 0{\cdot}0001$; **Toronto pain management inventory.

Nurses' pain knowledge and characteristics

Support was demonstrated for the hypothesis that nurses' pain knowledge was influenced by their birthplace and pain inservice education. The TPMI was significantly associated with birthplace (Eta = 0·39), with the lower TPMI scores for nurses from non-Western birthplaces differing significantly using HSD *post hoc* comparisons ($F_{4\cdot88} = 4{\cdot}04$, $P < 0{\cdot}005$). Filipino nurses were the least likely to ask for dose changes for unrelieved pain ($F_{4\cdot88} = 3{\cdot}89$, $P < 0{\cdot}006$) and were more likely to believe that patients overstate their pain than were other groups ($F_{4\cdot88} = 3{\cdot}44$, $P < 0{\cdot}01$). Birthplace contributed the most (16%) to the total of variance explained (31%) in the TPMI regression model. A weak positive correlation was evident between pain knowledge and continuing education ($r = 0{\cdot}21$, $P < 0{\cdot}05$), despite 84% of nurses having had little (32%) or no (52%) pain-related inservice education. No relationships existed between nurses' knowledge and their age, unit experience, nursing experience, or education level. There was no significant relationship between the Social Desirability Scale and the TPMI.

Differences in TPMI scores between sites were statistically significant ($F_{3\cdot90} = 5{\cdot}08$, $P < 0{\cdot}003$). Nurses' participation in pain inservice education also differed significantly by site, $\chi^2(12) = 27$, $P < 0{\cdot}008$. Site explained 11% of the variance in the regression model for nurses' knowledge.

Discussion

The Agency for Health Care Policy and Research (AHCPR 1992), the American Pain Society (APS 1995), and the Canadian Pain Society (CPS) (Watt-Watson *et al.* 1999) all advocate that pain relief needs to be a priority to prevent or reduce acute pain. The CPS Position Statement on Pain Relief (Watt-Watson *et al.* 1999) and the new standards from the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) (2000) (www.jcaho.org) both emphasize that patients have the right to appropriate assessment and management of pain. However, the majority of patients in this study reported considerable unrelieved pain and were undermedicated.

Nurses' pain knowledge was not associated with less pain or adequate analgesia for their assigned patients after CABG surgery. Most nurses rated their pain knowledge and management competence as excellent, despite moderate knowledge scores and minimal or no recent pain-related inservice. The sources of their pain information are not known. Clarke *et al.* (1996) found that hospital orientation programmes offered the least information about pain, and that most nurses reported learning more from informal information sources, such as personal experience and colleagues, than from formal education. The lack of trust in patients' self-report suggested that some nurses had their own benchmark of what pain level was acceptable and, possibly, when and how pain was to be expressed. Further exploration is required to explain why nurses gave only 47% of the average analgesic dose prescribed for patients who experienced moderate to severe pain. Although policy required documentation of pain as a 5th vital sign in one site, charting of pain was minimal, and high pain ratings did not result in an increase in analgesic administration. Levels of professional education and inservice education, which were very similar within this nurse group, did not provide enough variance for analysis.

An explanation of why nurses said they used an assessment tool that two-thirds of their patients did not remember is difficult. Patients were asked about the nurse who cared for them on the day of the interview in order to minimize memory lapses. Nurses may have been giving the investigator their 'best' answer and not describing their actual practice, and/or patients may not have recognized the intent of the nurse's question. Most patients rated their pain as mild at rest, but moderate to severe on movement; nurses who did not explore beyond general questions about pain would not have known about this difference. This lack of specific assessment about pain on movement may have been a reason why nurses did not administer analgesia. As well, nurses may not have recognized the greater potential for pain for patients with internal thoracic grafts related to the time involved,

surgical positioning, and complexity of the harvesting procedures, including electrocautery (Jansen & McFadden 1986, Heye 1991, Cohen *et al.* 1993). Nurses expected patients to communicate their pain and related management needs, but many patients did not agree. Educational strategies must emphasize the variability of pain and importance of patient involvement to help nurses move beyond problematic standardized expectations of postoperative pain.

The majority of these nurses, independent of their knowledge levels, perceived their nurse and medical colleagues to be supportive of their pain management decisions. However, nurses who lack knowledge of their patients' pain levels and options for treatment would be unlikely to challenge the status quo. Where nurses have been actively involved in improving pain practices, such as in the position of Pain Resource Nurse, difficulties have been experienced both with coworkers and doctors (Ferrell *et al.* 1993).

Although knowledge scores were not significantly related to nurses' age, experience, or education level, a significant association with birthplace explained 16% of the variance with nurses from non-Western birthplaces scoring significantly lower. Brunier *et al.* (1995) also reported that nurses educated in the Philippines had significantly lower knowledge scores than nurses educated in Canada or Britain. Analgesics in some countries such as the Philippines, particularly opioids, are not readily available, and their use has been restricted (Hong Zhang 1995, Laudico 1995). While inadequate knowledge in Western countries has been problematic despite the availability of considerable resources, non-Western cultural beliefs and experiences must also be recognized for their impact on pain management practices in Westernized settings.

This study is the first known to examine direct relationships between nurses' stated knowledge and pain management outcomes with their assigned postoperative cardiac patients. Power was adequate to answer the research questions. The design and analyses were appropriate. Study limitations included the lack of independence of the nurse measures for each patient linked with the nurse; 72% of these nurses were assigned to two or more patients. Therefore, data from patients cared for by the same nurse were averaged; using the same data from the nurses multiple times, once for each patient, would violate assumptions for most statistical tests. Furthermore, aggregating across multiple patients tends to cancel out random errors, leading to more accurate estimates of parameters. For analyses of pain and analgesia given over the previous 24 hours, scores of nurses from this sample (90·4%) of nurses employed in these settings were used to represent all nurses caring for the patient over the 24-hour time period. Although 3-hour pain correlated highly with 24-hour pain ($r = 0{\cdot}82$, $P < 0{\cdot}0001$), attributing 24-hour nursing to one nurse may have reduced statistical relationships in subsequent analyses. The TPMI was pretested with only minor modifications being required. All measures were then pilot tested with a surgical population. However, the minimal relationship between patients' pain ratings and nurses' knowledge may have reflected a lack of validity with some TPMI items. Further psychometric testing is in progress to evaluate the validity of this instrument.

Conclusion

This study examined nurses' expressed knowledge about pain and their pain management practices as confirmed by their nursing interventions related to analgesics and their patients' self-reports of pain. Both nurses and patients need clarification of the patient role in pain management. Addiction concerns continue to be evident and need to addressed by educators. To understand the contribution of knowledge to pain practices more clearly, investigators should include a stratified sample related to nurses' level of education in future research.

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Appendix A Toronto pain management inventory

Nurse information

(a) Education level: RN___ BScN___ MScN/MN___ other___
(b) Years of nursing experience ____ years
(c) Years working on *this* unit: ____ years
(d) Gender: F___ M___
(e) Place of birth: _____
(f) Language spoken at home:_____
(g) Age: ____ years
(h) Prior pain continuing education sessions:
none___ < 3 hours___ half day___ full day___ other___

Please place a mark (/) on the following lines:

(1) What percentage of patients in hospital who take opioids for pain become addicted?
0%_____100%

(2) With effective management, what pain rating should patients experience after surgery?
No pain 0_____100 worst pain ever

(3) How often do patients tend to overstate their pain? (i.e. what percentage of the time)
Never 0%_____100% always

(4) How often do you agree with patients' statements about their pain?
Never 0%_____100% always

(5) To what degree is pain relief directly related to the type of surgery the patient has had?
Never 0%_____100% always

(6) How often do patients tell you without being asked that they are having pain?
Never 0%_____100% always

(7) How often do patients ask you voluntarily for an analgesic?
Never 0%_____100% always

(8) What percentage of postoperative patients *where you work* experience mild or less pain?
0%_____100%

Appendix A (Continued)

(9) What percentage of postoperative patients *where you work* experience moderate pain?
0%_____100%

(10) What percentage of postoperative patients *where you work* experience severe pain?
0%_____100%

(11) What percentage of the time would you give opioid analgesics orally where there is a choice of route?
Never 0%_____100% always

(12) What pain rating should patients have before the next analgesic dose is given?
No pain 0_____100 worst pain ever

(13) How often do you tell patients that they need to wait for their next analgesic?
Never 0%_____100% always

(14) How often would you give surgical patients analgesics for their chronic pain if they can be distracted?
Never 0%_____100% always

(15) A 45-year-old-construction worker still complains of severe incisional pain 2 days after surgery despite taking tylenol no. 3 tabs ii q4h. After checking for infection, would you give him the ordered morphine 10 mg SC q4h?
Never 0%_____100% always

(16) Mrs N's morphine has been increased within a range because of her unrelieved pain. She has begun to experience nausea and is given an antiemetic. Your nursing colleague suggests you should also decrease the morphine dose. Would you follow this advice?
Never 0%_____100 always

(17) Mr Z, in spite of receiving morphine 10 mg SC q4h, continues to report moderate pain on his first postoperative day. Would you ask the physician for a higher dose?
Never 0_____100 always

(18) How difficult is it on your unit to have analgesic orders changed when your patients continue to experience pain?
Not difficult 0_____100 extremely difficult

(19) To what degree do nurses on your unit agree with your decisions about managing a patient's pain?
Never 0%_____100% always

(20) To what degree do physicians on your unit agree with your decisions about managing a patient's pain?
Never 0%_____100% always

(21) How often do you use a rating scale to assess pain (e.g. 0–10)?
Never 0%_____100% always

(22) How adequate do you feel your current knowledge is about pain assessment and management?
Not adequate 0_____100 very adequate

(23) How competent do you feel in effectively managing patients who are having pain?
Not competent 0_____100 very competent

Thank you very much for your help
Judy Watt-Watson