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To What Extent Do Surgical Ward Nurses Know About and Feel Confident in Managing Patient-Controlled Analgesia (PCA) Devices?

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Abstract

Background

Patient-controlled analgesia (PCA) allows patients to self-administer preset analgesic doses for postoperative pain. Safe use depends on nurses' knowledge of device design, setup, administration, and adverse-effect management. This study assessed surgical ward nurses' knowledge of and attitudes toward intravenous PCA and examined associated demographic and professional factors.

Methods

A descriptive cross-sectional study included 252 nurses at King Saud Medical City, Riyadh, Saudi Arabia. The nurses worked in general surgery, orthopedic, and trauma wards (200-, 300-, and 400-series wards and Tower 1), obstetrics and gynecology (OB/GYN) surgical wards (Tower 2), or the post-anesthesia care unit (PACU). Data were collected using an anonymous online questionnaire adapted from a published study, including a 20-item true/false PCA knowledge inventory and a 15-item attitude inventory rated on a five-point Likert scale. Knowledge scores below 60% were classified as low; attitude scores of 56 or higher out of 75 indicated a positive attitude. Internal consistency was assessed using Kuder-Richardson Formula 20 (KR-20) and Cronbach's alpha. Associations were examined using chi-square tests, binary logistic regression, and Spearman's rank correlation, with $p < 0.05$ considered statistically significant.

Results

The mean knowledge score was 9.04 ± 4.31 out of 20, and 190 nurses (75.4%) had low knowledge. The mean attitude score was 61.02 ± 9.68 out of 75, and 192 nurses (76.2%) had a positive attitude. Although 239 nurses (94.8%) reported prior PCA experience, only 39 (15.5%) correctly answered the respiratory depression item. Knowledge level was not significantly associated with the demographic or professional variables examined. Positive attitude was associated with age 41-50 years (n = 17) compared with 21-30 years (n = 85) (OR = 10.520, 95% CI: 1.041-106.324; p = 0.046) and with assignment to Tower 1 wards (n = 59) compared with 200-series wards (n = 61) (OR = 3.806, 95% CI: 1.307-11.080; p = 0.014). Knowledge and attitude scores showed a weak negative correlation (Spearman's r = −0.215; $p < 0.001$). Internal consistency was 0.818 for knowledge (KR-20) and 0.888 for attitude (Cronbach's alpha).

Conclusions

Favorable attitudes toward PCA coexisted with substantial knowledge gaps, particularly in safety-critical areas. Clinical experience alone did not correspond to adequate theoretical knowledge. These findings support structured, competency-based PCA education and close collaboration with the Acute Pain Service to improve postoperative pain management and patient safety.

Categories: Medical Education, Quality Improvement, Anesthesiology
Keywords: intravenous patient-controlled analgesia, nurse's knowledge, nursing staff education, opioid-induced respiratory depression, postoperative pain

Introduction

Inadequately controlled postoperative pain is still a common clinical problem. Data from the United States suggest that over 80% of surgical patients have inadequately controlled pain around the time of surgery, and between 31% and 58% still describe their pain as moderate or severe in the two weeks after discharge [1,2]. Uncontrolled acute pain has been linked to delayed mobilization, pulmonary complications, and prolonged hospitalization. For every 10% more time spent in severe pain on the first postoperative day, the incidence of chronic postsurgical pain has been reported to rise by 30%, and managing chronic pain over a lifetime can cost up to one million US dollars per patient [3,4]. A Cochrane meta-analysis pooling 49 randomized controlled trials reported that, relative to opioid regimens the patient did not control, intravenous patient-

controlled analgesia (IV-PCA) reduced pain scores by roughly nine points on a 100-point visual analogue scale across 0-24 hours and raised patient satisfaction (81% versus 61%), with no significant difference in serious adverse events [5]. Nursing competence in four areas underpins safe IV-PCA: the design of the device, pump setup, administration, and the management of opioid-related adverse events. Opioid-induced respiratory depression (OIRD), characterized by progressive sedation and a declining respiratory rate, is a serious complication that demands protocol-driven monitoring. In an audit across eight hospitals, just 8.3% of patients receiving IV-PCA met minimum opioid safety standards, and none needed naloxone rescue, indicating a direct and avoidable link between OIRD and lapses in nursing surveillance [6]. PCA by proxy, where a caregiver presses the demand button on the patient's behalf, is a further serious cause of PCA-related respiratory failure, and structured nursing education and vigilance can prevent it [7]. Educational level, clinical experience, and ward-specific training influence how much nurses know about pain management and how they feel about it. The determinants of PCA-specific competency, however, remain poorly described because most previous work has assessed knowledge of individual analgesics rather than the combined technical and safety skills required for IV-PCA management [8,9]. Two separate studies found that knowledge gaps in managing opioid side effects and setting the lockout interval persisted even after formal PCA training, which suggests that educational programs are not well aligned with the areas of greatest clinical risk [8,9]. In Saudi Arabia, nurses care for IV-PCA patients more frequently than in other international settings, yet their competence has not been systematically evaluated and remains unclear [10]. This study therefore focused on registered nurses working in the surgical wards and the post-anesthesia care unit (PACU) of King Saud Medical City, Riyadh. The primary objective was to assess nurses' knowledge of IV-PCA in four domains: device design, pump setup, administration, and side-effect management. The secondary objectives were to (1) assess nurses' attitudes toward PCA, (2) identify the demographic and professional factors (age, educational level, years of experience, ward, and prior PCA experience) associated with knowledge and attitude levels, and (3) examine the correlation between knowledge and attitude scores.

Materials And Methods

Study design

Following earlier studies [8,9], the study adopted a cross-sectional design to measure nurses' knowledge of patient-controlled analgesia (PCA) and attitudes toward it, and to explore which factors are related to knowledge and attitude levels.

Participants and setting

Participants were registered nurses working in the surgical wards of King Saud Medical City, Riyadh, and in the post-anesthesia care unit (PACU). The 200-, 300-, and 400-series wards are general surgery, orthopedic, and trauma surgical wards, and patients are admitted to them according to bed availability. Tower 1 wards mainly receive general surgery, orthopedic, and trauma cases, whereas Tower 2 wards receive obstetrics and gynecology (OB/GYN) surgical cases. In the questionnaire, nurses selected their ward from a coded list: 200A, 200B, 200D, 200G, and 200H (200-series); 300B, 300D, and 300G (300-series); 400A, 400B, and 400D (400-series); T1A4, T1B5, and T1B6 (Tower 1); T2A6, T2B6, and T2B7 (Tower 2); and the PACU. Inclusion required that nurses were providing patient care and had agreed to take part; any incomplete questionnaire was excluded from analysis.

Raosoft's online calculator (Raosoft Inc., Seattle, USA) was used to estimate the required sample size. The inputs were a population size of 729 nurses, a margin of error (precision) of 5%, a confidence level of 95% (corresponding to a Z-value of 1.96), and a response distribution of 50%, which is the most conservative assumption because it yields the largest sample. On this basis, the calculator recommended 252 participants, so the findings carry a 95% confidence level and a maximum margin of error of ±5%.

Study instrument

Three sections made up the structured questionnaire used for data collection, adapted from Chen et al. [8]:

Sociodemographic Characteristics

Respondents gave their age, educational level, years of work experience, ward, and whether they had used PCA in patient care.

Knowledge of PCA

Twenty statements, each answered as true or false, assessed PCA knowledge. A correct response earned one point; incorrect responses earned none. Total scores therefore lay between 0 and 20 and were multiplied by 5 to give a percentage. In line with previous studies [8], scores under 60% denoted low knowledge and scores of 60% or more denoted high knowledge. For each knowledge item, we also counted the correct answers and expressed them as a percentage.

Attitude Toward PCA

Attitudes were captured with 15 Likert-type items scored from 1 (never) to 5 (always), where 2 meant rarely, 3 sometimes, and 4 often; scores of 1-3 indicated a negative attitude and 4-5 a positive one. Item 15, which described the variety of administration routes and drugs used with PCA as a potential cause of nurse error, was negatively worded and so reverse-coded (6 minus the original score). The total score ran from 15 to 75 and, as in earlier studies [8], a total below 56 denoted a negative attitude while 56 or above denoted a positive attitude. We also determined the number and proportion of positive answers to each attitude item.

Data analysis

The SPSS Statistics software (IBM Corp., Armonk, USA) was used for all analyses. Participants' demographic profile and their answers to the knowledge and attitude items were described by frequencies and percentages.

Both scales were tested for reliability. For the true/false knowledge items, internal consistency was assessed through the Kuder-Richardson Formula 20 (KR-20), which is Cronbach's alpha applied to dichotomous data [11]; for the Likert-scored attitude items, Cronbach's alpha itself was used.

Chi-square tests examined whether knowledge level and attitude level were associated with demographic and work-related variables.

To identify factors linked to knowledge and attitude levels, binary logistic regression was performed with knowledge level and attitude level as outcomes. Age group, education level, years of experience, ward group, and PCA experience were entered as predictors, all at once so as to adjust for possible confounding biases. Odds ratios (ORs), beta coefficients (β), 95% confidence intervals (CIs), and p-values were derived, and the Hosmer-Lemeshow test evaluated how well the model fit.

The Kolmogorov-Smirnov and Shapiro-Wilk tests evaluated whether knowledge and attitude scores were normally distributed, which dictated the choice between parametric and non-parametric correlation methods. Spearman's rank correlation coefficient was then applied to the relationship between the two scores. Results with $p < 0.05$ were regarded as statistically significant.

Ethical considerations

Nurses chose freely whether to take part, and responses were anonymous. They were told what the study was for and assured that their answers would stay confidential and be used only for research. The study adhered to the ethical principles of the Declaration of Helsinki, and reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The Institutional Review Board of King Saud Medical City, Riyadh, Kingdom of Saudi Arabia, approved the study (approval number H1RI-14-Oct25-04).

Results

Sociodemographic characteristics

Table *1* presents the sociodemographic profile of the 252 nurses who completed the questionnaire. The sample comprised 252 nurses with a mean age of 34.19 years (SD = 6.94). Just over half (55.8%) were aged 31-40 years, 33.9% were aged 21-30, 6.8% aged 41-50, and 3.6% aged 51 or above. Work experience averaged 6.25 years (SD = 5.23), and 54.4% had 0-5 years. Bachelor's degrees were held by 85.7%, diplomas by 9.5%, and master's degrees or higher by 4.8%. The ward distribution was 24.2% in 200-series wards, 18.7% in 300-series, 17.5% in 400-series, 23.4% in Tower 1, 4.4% in Tower 2, and 11.9% in the PACU, and 94.8% reported previous experience with PCA.

Variable	n (%)
Age (mean, SD: 34.19, 6.94)	
21–30 years	85 (33.9)
31–40 years	140 (55.8)
41–50 years	17 (6.8)
≥51 years	9 (3.6)
Experience (mean, SD: 6.25, 5.23)	
0–5 years	137 (54.4)
6–10 years	74 (29.4)
11–15 years	31 (12.3)
≥16 years	10 (4.0)
Education	
Diploma	24 (9.5)
Bachelor	216 (85.7)
Master and above	12 (4.8)
Ward group	
200-series wards	61 (24.2)
300-series wards	47 (18.7)
400-series wards	44 (17.5)
Tower 1	59 (23.4)
Tower 2	11 (4.4)
PACU	30 (11.9)
Prior PCA experience	
No	13 (5.2)
Yes	239 (94.8)

TABLE 1: Sociodemographic profile of the participants (N = 252)

The 200-, 300-, and 400-series wards are general surgery, orthopedic, and trauma surgical wards (patients are admitted according to bed availability). Tower 1 wards mainly receive general surgery, orthopedic, and trauma cases, and Tower 2 wards receive OB/GYN surgical cases. PACU, post-anesthesia care unit; PCA, patient-controlled analgesia.

Knowledge of PCA

Table *2* shows the number and percentage of nurses who answered each of the 20 knowledge items correctly. Individual knowledge items differed widely in the proportion answered correctly, from 15.5% to 86.9%. Best answered were item 1, on the patient-demand design of PCA (86.9%), item 5, on the components of PCA pump setup (82.9%), and item 4, on the routes of PCA administration (81.0%). The worst-answered items were item 11, on a respiratory rate below five breaths per minute (15.5%), item 15, on educating patients to reduce PCA use (18.7%), and item 2, on the mechanism of PCA (21.8%).

Item	Correct n (%)
1. The design of PCA is informed by the concept of patient-demand analgesic administration.	219 (86.9%)
2. The mechanism of PCA is the provision of a new analgesic to achieve a satisfactory analgesic effect and to maintain peak serum concentration.	55 (21.8%)
3. The definition of bolus dose for PCA is the maximum dose that reaches a moderate analgesic effect with the probability of moderate side effects.	61 (24.2%)
4. The common routes of administration for PCA include intravenous, epidural, and continuous subcutaneous injections (for terminal cancer patients and others).	204 (81.0%)
5. The setup of the PCA pump includes the loading dose, bolus dose, continuous dose, lockout interval, and 4 h-limit dose, among other components.	209 (82.9%)
6. The bolus dose of PCA should generally be set to half of the dose of intramuscular injection.	132 (52.4%)
7. The suggested lockout interval of intravenous PCA is 30 to 60 minutes.	115 (45.6%)
8. The medication used in IV PCA should be non-opioid analgesics because the side effects of these medications are limited.	119 (47.2%)
9. When a PCA overdose is suspected, the use of flumazenil as an antagonist should be considered to confirm the diagnosis.	102 (40.5%)
10. Because of the opioid analgesics used in PCA, the most common side effect is addiction.	73 (29.0%)
11. A respiration rate of less than five breaths per minute may be due to an overdose of PCA analgesics.	39 (15.5%)
12. To prevent addiction to IV PCA, the best choice of PCA analgesics is NSAIDs.	86 (34.1%)
13. The goal of pain relief is achieved when the caregiver uses the PCA equipment directly.	93 (36.9%)
14. The best advantage of PCA is that uncooperative patients can be prioritized for PCA administration.	111 (44.0%)
15. Although patients may use PCA by themselves, the nurse should educate the patient as much as possible to reduce the use of PCA to prevent overdose and side effects.	47 (18.7%)
16. The intended analgesic effect of PCA is that patients do not feel pain at all and their pain score is 0 out of 10 on the visual analogue scale; otherwise, it is necessary to increase the dose.	114 (45.2%)
17. It is acceptable to extend the use of PCA for 14 days if a patient requests it when the analgesic effect of PCA is satisfactory.	169 (67.1%)
18. The same class of IV PCA analgesics should be administered to achieve an analgesic effect when the effect of IV PCA is unsatisfactory.	117 (46.4%)
19. The analgesic used in IV PCA and epidural PCA is the same; therefore, it is possible to administer the epidural PCA analgesic directly via the intravenous route.	134 (53.2%)
20. Pain is a subjective feeling; thus, nurses' knowledge of pain and their options for treatment cannot influence the time and dosage of analgesic administration and the outcomes of postoperative pain control.	80 (31.7%)

TABLE 2: Correct responses to the PCA knowledge items (N = 252)

Each item was answered as True or False; one point was given for a correct answer and none for an incorrect answer. The correct answer is True for items 1, 4, and 5 and False for all other items. Items are listed in questionnaire order and are adapted from the PCA knowledge inventory reported by Chen et al. [8], which is an open-access article distributed under the terms and conditions of a Creative Commons Attribution 4.0 International License. PCA, patient-controlled analgesia; IV, intravenous; NSAIDs, nonsteroidal anti-inflammatory drugs.

The average knowledge score was 9.04 out of a possible 20 (SD = 4.31; 95% CI: 8.51-9.58); individual scores spanned 2 to 19, and the median was 9.00. By the cutoff, low knowledge was found in 190 nurses (75.4%) and high knowledge in 62 (24.6%). Internal consistency of the knowledge scale was good (Cronbach's α = 0.818).

Table 3 lists the safety-critical items that respondents most often answered incorrectly. The most frequently wrong answers concerned recognizing respiratory depression (84.5%), then addiction being the most common side effect (71.0%), caregivers pressing the PCA button (63.1%), the flumazenil antagonist item (59.5%), the lockout interval (54.4%), and IV PCA being equal to epidural analgesia (46.8%).

Safety-critical item	Correct answer	Incorrect responses n (%)	Safety domain
Item 7. The suggested lockout interval of intravenous PCA is 30 to 60 minutes.	False	137 (54.4%)	PCA setup
Item 9. When a PCA overdose is suspected, the use of flumazenil as an antagonist should be considered to confirm the diagnosis.	False	150 (59.5%)	PCA side-effect management
Item 10. Because of the opioid analgesics used in PCA, the most common side effect is addiction.	False	179 (71.0%)	PCA side-effect management
Item 11. A respiration rate of less than five breaths per minute may be due to an overdose of PCA analgesics.	False	213 (84.5%)	PCA side-effect management
Item 13. The goal of pain relief is achieved when the caregiver uses the PCA equipment directly.	False	159 (63.1%)	PCA administration
Item 19. The analgesic used in IV PCA and epidural PCA is the same; therefore, it is possible to administer the epidural PCA analgesic directly via the intravenous route.	False	118 (46.8%)	PCA administration

TABLE 3: Safety-critical misconceptions in PCA management (N = 252).

Item numbers refer to the items in Table 2. Each item was answered as True or False, and the correct answer for every item listed is False. Items are listed in questionnaire order and are adapted from the PCA knowledge inventory reported by Chen et al. [8], which is an open-access article distributed under the terms and conditions of a Creative Commons Attribution 4.0 International License. PCA, patient-controlled analgesia; IV, intravenous.

Attitude toward PCA

Table 4 shows the number and percentage of nurses who responded positively to each attitude item. Attitude items drew positive responses from 11.1% to 86.9% of nurses. Agreement was highest for item 9, on PCA-related training (86.9%), item 8, on educating patients about PCA (85.3%), and item 11, on PCA as a safe mode of administration (84.5%), and lowest for the reverse-coded item 15, on routes and drugs as a potential source of error (11.1%).

Item	Positive response n (%)
1. You can conduct a pain assessment when you care for patients experiencing pain.	192 (76.2%)
2. You can accept patients' subjective judgments when they complain of pain.	187 (74.2%)
3. You can evaluate the severity of pain, vital signs, consciousness level, mental status, and history of allergy to opioids before giving patients access to PCA.	212 (84.1%)
4. You would not ask patients to endure their pain because of concerns regarding side effects (i.e., overdose) when patients complain that opioid analgesics are ineffective.	140 (55.6%)
5. You re-evaluate patients' pain and discuss adjustments to the type, route, and dosage of analgesics with the doctor when a patient complains that analgesics are ineffective.	205 (81.3%)
6. You evaluate patients continually and discuss the adjustment of analgesic doses with doctors in a timely manner for high-risk patients, such as individuals with poor renal function, obesity, or obstructive sleep apnea, and for those older than 70 years old, who are more likely to experience side effects when using opioid analgesics.	194 (77.0%)
7. You agree that analgesic-relevant training helps you understand how to use analgesics and evaluate the effects and adverse side effects of analgesics.	207 (82.1%)
8. You educate patients using PCA on the adverse side effects of opioids and how to use the PCA device.	215 (85.3%)
9. You agree that PCA-knowledge-relevant training helps you understand how to educate patients to use PCA and address the problems resulting from PCA.	219 (86.9%)
10. When patients experience pain, you encourage them to push the button for PCA administration immediately and tell them that it will not result in an overdose.	181 (71.8%)
11. You agree that PCA is a safe mode of medication administration and that it can relieve patients' pain effectively.	213 (84.5%)
12. You agree that PCA is easy to use and to troubleshoot.	183 (72.6%)
13. You agree that PCA can help to reduce the dose of analgesics required and the occurrence of side effects.	193 (76.6%)
14. You evaluate patients' needs and ask doctors to recommend the use of PCA to patients.	180 (71.4%)
15. You believe that the various routes and medication types for administering PCA are a potential source of error for nurses during analgesia administration (reverse-coded).	28 (11.1%)

TABLE 4: Positive responses to the PCA attitude items (N = 252).

Each item was rated on a five-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). A positive response was a score of 4 or 5. Item 15 is reverse-coded, so a positive response to it indicates disagreement with the statement. Items are listed in questionnaire order and are adapted from the PCA attitude inventory reported by Chen et al. [8], which is an open-access article distributed under the terms and conditions of a Creative Commons Attribution 4.0 International License. PCA, patient-controlled analgesia.

The mean attitude score was 61.02 of 75 (SD = 9.68; 95% CI: 59.82-62.22), with scores from 30 to 74 and a median of 64.00. Sixty nurses (23.8%) scored below the cutoff and had a negative attitude, whereas 192 (76.2%) had a positive attitude. Internal consistency of the attitude scale was excellent (Cronbach's α = 0.888), reflecting high reliability.

Associations of demographic and work-related variables with knowledge and attitude levels

No significant association emerged between knowledge level and age group (χ^2 = 1.462, p = 0.691), education level (χ^2 = 2.000, p = 0.368), years of experience (χ^2 = 0.610, p = 0.894), ward (χ^2 = 5.214, p = 0.390) or PCA experience (χ^2 = 0.628, p = 0.428) in the chi-square tests.

Attitude level, by contrast, was significantly associated with age group ($\chi^2 = 8.133$, p = 0.043) and ward group ($\chi^2 = 12.625$, p = 0.027), whereas education level ($\chi^2 = 0.747$, p = 0.688), years of experience ($\chi^2 = 4.095$, p = 0.251) and PCA experience ($\chi^2 = 0.004$, p = 0.949) showed no significant association (Table 5).

Variable	PCA knowledge β	PCA knowledge OR	PCA knowledge 95% CI	PCA knowledge p-value	PCA attitude β	PCA attitude OR	PCA attitude 95% CI	PCA attitude p-value
Age (years)								
21–30	Reference				Reference			
31–40	0.534	1.706	0.756–3.851	0.198	0.606	1.834	0.818–4.111	0.141
41–50	0.707	2.028	0.507–8.118	0.318	2.353	10.520	1.041–106.324	0.046
≥51	-0.045	0.956	0.145–6.295	0.963	1.729	5.632	0.401–79.139	0.200
Education								
Diploma	Reference				Reference			
Bachelor	-1.102	0.332	0.065–1.709	0.187	-0.029	0.971	0.149–6.314	0.976
Master and above	-0.808	0.446	0.123–1.611	0.218	0.506	1.659	0.381–7.228	0.500
Experience (years)								
0–5	Reference				Reference			
6–10	-0.367	0.693	0.311–1.544	0.370	-0.275	0.760	0.334–1.728	0.512
11–15	-0.024	0.977	0.359–2.656	0.963	0.879	2.410	0.588–9.876	0.222
≥16	0.609	1.838	0.329–10.261	0.488	-1.138	0.320	0.035–2.964	0.316
Ward								
200-series wards	Reference				Reference			
300-series wards	-0.464	0.629	0.243–1.625	0.338	-0.062	0.940	0.400–2.207	0.887
400-series wards	0.168	1.184	0.488–2.870	0.709	-0.025	0.975	0.394–2.415	0.957
Tower 1	-0.749	0.473	0.183–1.225	0.123	1.337	3.806	1.307–11.080	0.014
Tower 2	-0.018	0.982	0.225–4.287	0.981	-0.499	0.607	0.148–2.482	0.487
PACU	0.257	1.294	0.447–3.745	0.635	0.962	2.617	0.729–9.394	0.140
PCA experience								
No	Reference				Reference			
Yes	0.772	2.164	0.423–11.068	0.354	0.524	1.689	0.380–7.514	0.491

TABLE 5: Binary logistic regression of knowledge and attitude levels on demographic and work-related variables (N = 252).

N = 252 nurses were included in each regression model. The binary outcomes were PCA knowledge (high = score of 60% or more, i.e., at least 12 of 20; low = below 60%, reference) and PCA attitude (positive = total score of 56 or more; negative = below 56, reference). Odds ratios (ORs) are adjusted: age group, education level, years of experience, ward group, and PCA experience were entered simultaneously in each model. β is the logistic regression coefficient, the change in the log odds of the outcome (high knowledge or positive attitude) relative to the reference category of each predictor (OR = exp(β)). CI, confidence interval; PACU, post-anesthesia care unit; PCA, patient-controlled analgesia.

Logistic regression analysis

Table 5 shows the results of the binary logistic regression for knowledge and attitude levels. None of the variables significantly predicted knowledge level. Nurses aged 41-50 years had higher odds of a positive attitude than those aged 21-30 years (OR = 10.520, 95% CI: 1.041-106.324, p = 0.046). Likewise, working in Tower 1 wards rather than 200-series wards was associated with higher odds of a positive attitude (OR = 3.806, 95% CI: 1.307-11.080, p = 0.014).

Normality test

Both knowledge scores and attitude scores departed from a normal distribution (Kolmogorov-Smirnov $p < 0.001$ and Shapiro-Wilk $p < 0.001$ for each).

Correlation between knowledge and attitude scores

A statistically significant negative correlation was found between knowledge and attitude scores on Spearman's rank correlation ($r = -0.215$, $p < 0.001$).

Discussion

Knowledge toward PCA

Nurses' PCA knowledge was poor overall. Three quarters (75.4%) fell into the low-knowledge group and just 24.6% into the high-knowledge group, and a mean score of 9.04 out of 20 shows that the typical nurse got under half of the questions right. These gaps in PCA management knowledge echo earlier reports of limited knowledge and misconceptions about opioid side-effect management and PCA use [12]. Although 54.4% of respondents had five years of experience or less, years of experience was not associated with knowledge level in the chi-square test ($p = 0.894$) or in the adjusted regression model (all $p > 0.30$). The predominance of less-experienced nurses, therefore, does not appear to explain the low scores, although the small number of nurses with 11 or more years of experience ($n = 41$) limited the power of this comparison.

The lowest rates of correct answers were for respiratory depression, the mechanism of PCA, and reducing PCA use, all relevant to clinical practice and patient safety. Misconceptions on safety-critical points were also seen for recognizing respiratory depression, regarding addiction as the commonest side effect, and caregivers using the PCA button. Earlier studies have described similar misconceptions about opioid addiction and respiratory depression [12,13]; these matter clinically, as such misunderstandings could result in inappropriate PCA management and endanger patients. The present results likewise fit prior research documenting inadequate nursing knowledge of PCA, in particular of opioid side effects, overdose management and PCA safety protocols [8,9]. Inadequate training, a shortage of continuing education programs, or restricted clinical exposure to PCA management might explain this.

Attitude toward PCA

Even with low knowledge scores, 76.2% of nurses held a positive attitude toward PCA, and a mean attitude score of 61.02 out of 75 points to broadly favorable opinions of PCA for pain management. Earlier research likewise found that nurses tended to be positive about PCA despite limited knowledge [8].

Positive attitudes predominated for pain assessment, patient education, PCA safety, and the usefulness of PCA training, suggesting that nurses value PCA in pain management and are prepared to use it clinically. In contrast, the reverse-coded item on PCA routes as a source of error had a low positive response rate, possibly reflecting worry about medication administration errors or low confidence in handling PCA.

Earlier work has also described positive attitudes coexisting with low knowledge, which may indicate that nurses who are willing to use PCA and trust its benefits nonetheless lack the knowledge to manage it safely and effectively [9]. Targeted education and training programs therefore seem important, given evidence that they improve knowledge and attitudes in pain management [12,14].

Determinants of PCA knowledge and attitude

Knowledge level was not significantly related to any demographic or work-related variable (age, education level, years of experience, ward or PCA experience), implying that knowledge deficits cut across demographic and professional groups rather than being confined to one subgroup of nurses. Previous studies similarly noted that higher education or longer work experience did not always accompany higher knowledge scores [8].

Attitude level, however, differed significantly by age group and ward. In logistic regression, nurses aged 41-50 years were 10.52 times more likely than those aged 21-30 years to hold a positive attitude toward PCA (OR = 10.52, 95% CI: 1.041-106.324, p = 0.046), in keeping with earlier work showing that older, more experienced nurses had more positive attitudes toward PCA [9].

Nurses working in Tower 1 wards were also 3.81 times more likely to hold a positive attitude toward PCA

than nurses in 200-series wards (OR = 3.81, 95% CI: 1.307-11.080, p = 0.014). Earlier reports suggest that the work unit may shape nurses' knowledge and attitudes about pain management through differing clinical exposure and training opportunities [15].

Correlation between knowledge and attitude

A statistically significant but weak negative correlation emerged between knowledge and attitude scores (r = −0.215): nurses with higher knowledge scores tended to have slightly lower attitude scores. Earlier studies likewise reported that knowledge and attitude did not always move in the same direction [8].

A possible explanation is that better-informed nurses are more conscious of PCA's complications, risks, and difficulties, which can temper their attitudes, while less-informed nurses may be more optimistic because they see fewer risks. Some earlier studies have also found knowledge and attitude to be not always positively correlated.

Reliability of the instruments

Internal consistency was good for the knowledge scale (Cronbach's α = 0.818) and excellent for the attitude scale (Cronbach's α = 0.888), comparable with the acceptable reliability earlier studies found for PCA knowledge and attitude instruments [8,9].

Study implications

Educational and training programs are needed to improve nurses' PCA knowledge, especially on safety topics such as recognizing respiratory depression, opioid side effects, and PCA safety protocols, as these findings highlight. Earlier studies have shown that such programs significantly improve knowledge and attitudes regarding pain management [12,14].

Limitations

Several limitations apply. First, participation was voluntary, as required by research ethics, so the sample may be affected by self-selection (non-response) bias. Nurses who were less familiar with PCA, less engaged in continuing education, or less confident in their knowledge may have been less likely to respond. Because such nurses would probably have scored lower, this bias would tend to inflate the observed knowledge and attitude levels, and the true knowledge deficit among all nurses in these wards may be larger than reported. Future assessments could include all nurses who manage PCA by embedding the knowledge test into mandatory PCA competency training.

Second, the data came from only one hospital, so generalizability may be limited. Third, the questionnaire was self-administered, which introduces potential response bias, including socially desirable responses on the attitude items, although responses were anonymous. Fourth, the cross-sectional design prevents causal inference. Lastly, knowledge scores were low despite most respondents having prior PCA experience, which may reflect uneven training quality or variability in clinical practice.

Conclusions

Nurses' positive attitudes were accompanied by a substantial shortfall in actual knowledge of postoperative pain management with IV-PCA. Most general nurses reported favorable attitudes and frequent clinical exposure to PCA, yet only a minority had a satisfactory level of knowledge about its design, setup, administration, and side-effect management. More attention should therefore go to structured, competency-based PCA education for general nurses, because clinical experience alone did not produce adequate theoretical knowledge.

The nurses viewed PCA as an effective and valuable way to treat postoperative pain, especially after major surgery where moderate to severe pain is anticipated. Even so, the safety-critical misconceptions identified show that positive attitudes are no replacement for technical competence. Safe and effective postoperative PCA requires continued education for general nurses and prescribers and close cooperation with the Acute Pain Service team.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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