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EVIDENCE-BASED PAIN MANAGEMENT NURSING PRACTICE IN CRITICALLY ILL TRAUMA PATIENTS: A CASE STUDY REPORT

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ABSTRACT

Purpose : In critical care settings, many patients are unable to self-report regarding pain and face many other barriers which are compromised by the effective use of analgesics. This study was done to apply and evaluate the selected pain assessment tool for critically ill and for the patient failing to self-report in order to implement the evidence-based nursing intervention and to maximize pain relief.

Methods : This is a case study report. Four critically ill patients who were experiencing pain and unable to self-report pain in trauma were conveniently selected. Researchers applied the Critical-Care Pain Observation Tool (CPOT), for assessing pain in the patients and implemented the evidence-based nursing intervention, foot and hand massage, for reducing pain. The applicability of the CPOT and the effectiveness of foot and hand massage have been discussed in the present paper.

Results : The CPOT has showed good sensitivity. For patient 1, the CPOT pain score increased from 2 and 1 before suction to 4 and 5 during suction respectively. For patient 2, the score increased from 0 before dressing change to 2 during dressing change. For patient 3, the score decreased from 8 before administrating analgesics to 1 after administrating analgesics. Moreover, the CPOT score (8) was consistent with the self-report pain level (severe pain) in patient 3. The massage appeared to be effective in reducing pain. For patient 3, the score decreased from 8 before massage to 4 immediately after massage and similarly for patients 4 the score also decreased from 3 to 2.

Conclusion : Although the degree of representation of the results is limited to a sample of four patients. The present study recommended the utility of the CPOT pain tool and foot and hand massage for managing pain in critically ill patients.

Keywords : *Evidence-based practice, Pain management, Critically Ill Trauma Patients*

INTRODUCTION

Recent studies have revealed that pain is still a common problem for many patients in critical care settings (Ahlers *et al.*, 2010 Graf and Puntillo, 2003). Pain in critically ill patients may come from many sources such as some particular illness, surgery, trauma, or the medical care associated with the illness, including phlebotomy, chest tubes, dressing changes, endotracheal tubes, turning, restraints, or suction (Morrison *et al.*, 1998; Puntillo *et al.*, 2009).

It is increasingly clear that inadequate pain management affects patients' quality of life especially in physical disability and psychological distress by increasing the risk of developing myocardial infarction, respiratory failure, depression, and delirium (Aubrun and Marmion, 2007). Therefore, providing effective pain management for critically ill patients is very important and at the same time challenging. But pain assessment in critically ill patients is complex. Pain is a subjective experience, therefore, self-report is the most reliable way for accurate assessment of pain (Pasero, 2003). However, many factors in critical care settings compromise with patients' ability to self-report their pain. These commonly include the use of sedative agents, mechanical ventilation, and the patients' change in the level of consciousness (Shannon and Bucknall, 2003). Therefore, nurses need to select the appropriate pain assessment tool for critically ill patients with behavioral observation tool rather than

the commonly used self-report tool. Again, although pain medication is the most effective way to relieve pain, many specific barriers exist in critical care settings that compromise the use of effective pain medication such as mechanical ventilation, delirium along with the need for balancing hemodynamic stability (Graf and Puntillo, 2003). Therefore, nonpharmacological interventions that can provide pain relief and reduce the dose requirement for analgesics (Rosenquist and Rosenberg, 2003) are essential for pain management in critically ill patients. Some nonpharmacological interventions have been examined for their ability to relieve pain such as cutaneous stimulation and massage, ice and heat therapies, distraction, guided imagery and relaxation techniques (Brunner and Suddarth, 2000). In critical care settings, the pharmacological management and nonpharmacological interventions should be combined together to achieve maximum pain relief for patients.

Since many patients in trauma ward are in critical state and pain is a common problem in those patients, the study would apply and evaluate the selected pain assessment tool for critically ill trauma patients who were unable to self-report and implement the evidence-based nursing intervention to maximum pain relief.

METHODS

Setting of Sample

This study was conducted at a university hospital in Thailand. Inclusion criteria were:

- critically ill adult patients (≥18 years old) admitted in trauma ward,
- experiencing pain and
- unable to self-report pain.

Finally, four patients were conveniently recruited.

DATA COLLECTION TOOL

I. Selecting the appropriate pain assessment tool

Many pain assessment tools have been developed for critically ill patients who are unable to self-report (Li *et al.*, 2008). Although no measurement of pain in patients who are unable to self-report has been accepted as the "gold standard", the Behavioral Pain Scale (BPS) and the Critical-care Pain Observation Tool (CPOT) are the generally proven and increasingly accepted ones (Herr *et al.*, 2006; Li *et al.*, 2008; Pudas-Tahka *et al.*, 2009). However, the nurses still need to consider the limitations of these tools in order to use them properly.

The BPS (Payen *et al.*, 2001) evaluates three behavioral domains including facial expression, movements of upper limbs and compliance with ventilation. It is a valid and reliable tool for use in critically ill nonverbal patients. However, it has several limitations such as unclear operational definitions, unreasonable scoring (e.g. 3 = no pain to 12 = most pain), and unreasonable explanation (e.g. the lack of body movement equates with a pain free state) (Li *et al.*, 2008).

The CPOT (Gelinas *et al.*, 2006) evaluates four behavioral domains including facial expression, body movements, muscle tension and ventilator compliance (intubated patients) or vocalization (extubated patients). Each domain is scored from 0 to 2 and the total possible score ranges from 0 "no pain" to 8 "most pain". The validity and reliability of the CPOT have been demonstrated in critically ill patients being unable to self-report such as sedated patients, unconscious and mechanically ventilated patients (Gelinas, 2010; Gelinas, Fillion, and Puntillo, 2009; Gelinas *et al.*, 2004; Gelinas, *et al.*, 2009; Gelinas and Johnston, 2007). However, the responsiveness of CPOT behaviors to painful stimuli in deeply sedated patients remains yet to be determined. The main concern relates to the fact that generally low CPOT score reflects low pain intensity level. However, low CPOT score can also be due to the unresponsive of the patients who would not display behaviorial changes (Li *et al.*, 2008). Therefore, this tool may not be suitable for deeply sedated and/or unresponsive patients.

Overall, the CPOT is more acceptable than the BPS. The CPOT contains operationally defined descriptors and employs an easy to use scoring system. Moreover, the CPOT has unique descriptors for patients who are intubated and for those who can verbalize, enhancing its clinical utility (Li *et al.*, 2008). Therefore, the CPOT appears to be a well-designed tool for studying critically ill patients who are unable to self-report and in the present study, the researchers have selected it for assessing pain in critically ill trauma patients.

Table-I Description of the Critical-Cue Pain Observation Tool

Indicator	Description	Score	
Facial expression	No muscular tension observed Presence of Relaxed,	neutral	0
	frowning* brow lowering* orbit tightening, and levator contraction	Tense	1
	All of the above facial movements plus eyelid tightly closed	Grimacing	2
Body movements	Does not move at all (does not necessarily mean absence of pain}	Absence of movements	0
	Slow, caytioys movements, toyching or rubbing the pain site, seeking attention through movements	Protection	1
	Pulling tybe, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed	Restlessness	2
Muscle tension Evaluation by passive flexion and extension of upper extremities	No resistance to passive movements	Relaxed	0
	Resistance to passive movements	Texse, rigid	1
	Strong resistance to passive movements, inability to complete them	Very tense or rigit	2
Compliance with the ventilator (intubated patients)	Alarms not activated, easy ventilation	Tolerating ventilator or movement	0
	Alarms stop spontantoysly	Coughing but tolerating	1
OR	Asynchrony: blocking ventilation, alarms frequently activated	Fighting ventilator	2
Vocalization (extybated patients)	Talking in normal tone or no soynd	Talking in normal tone or no sound	0
	Sighing, moaning	Sighing, moaning	1
	Crying out sobbing	Crying out sobbing	2
Total, range			0 - 8

Note : Data from Gelinas and Johnston (2007)

II. Selecting the evidence-based nursing intervention for reducing pain

The researchers selected five nursing interventions from the experimental studies including complementary therapy (Kshettry *et al.*, 2006), aromatherapy (Kim *et al.*, 2006), relaxation and music technique (Good *et al.*, 2005), systematic relaxation technique (Roykulcharoen and Good, 2004), and foot and hand massage (Wang and Keck, 2004). Although these selected interventions were tested in patients after surgery, all these interventions could be applied in critically ill patients for helping them to relieve or control pain. However, the complementary therapy involving music, guided imagery, gentle touch, and light massage was provided by the specialist. But it might be difficult for the general nurses to practice. In the aromatherapy, the lavender oil have mood-enhancing and analgesics properties (Barocelli *et al.*, 2004; Moss *et al.*, 2003). The oil was applied with a cotton swab on the inside of an oxygen face mask. Therefore, it is not applicable for use in critically ill and mechanically ventilated patients. The relaxation and music technique and systematic relaxation technique that need the patients to participate actively, may have big limitation when used in unconscious or sedated patients. The foot and hand massage, might have some limitation in case of some patients who have damaged tissue or skin on their feet or hands from surgery, arthritis, inflammation, edema, and burn wound. However, the foot and hand massage appears to be an effective, inexpensive, low-risk, flexible, and easily applied strategy for critically ill patients who might be conscious or unconscious. Therefore, the researchers selected the foot and hand massage intervention and developed the protocol in order to apply it into practice.

Finally, the Pain Management Tool was developed by the researchers in case of Critical Patients incapable to self-report to assess and document pain and its management. It included the following parts: demographic data, health related data, causes of pain, pain treatment, side effects of analgesics, pain assessment tool: CPOT and protocol of foot and hand massage intervention for reducing pain.

III. Protocols of Foot and hand massage to relieve pain (Wang and Keck, 2004)

Prior to the massage, the feet and hands are given a general visual inspection for swelling, color, ulcerations, wounds, areas indicating pressure, toe deformities, cleanliness, odor and condition of the nails and skin. Each patient is helped to be in a comfortable and unconstrained position in the bed and is assisted to a lying or half-lying position. The massage components include petrissage, friction, and kneading. Petrissage is the movement of the balls of the fingers and thumbs to apply direct pressure in a slow and rhythmic fashion to the soft tissue underlying the skin of the foot and hand. Friction is the movement of the knuckles in an up-and-down motion to stroke the sole. Kneading is the movement of the thumb and forefinger to knead the heel and ankle. The steps in the massage procedure are described in as followings:

1. The investigator holds the patient's hand gently in one of her/his hands.
2. The investigator uses thumb and fingers to make circles over the patient's entire palm, all fingers, and the outer surface of the hand.
3. The palm is spread out by the investigator's fingers.
4. Hand massage is applied to each hand for 5 minutes, avoiding an intravenous catheter-inserted area if applicable.
5. The foot massage begins by holding the foot gently but firmly in both of the investigator's hands.
6. The thumb is used to make circles over the entire sole of the foot.
7. The sole is spread by the investigator's fingers.
8. The knuckles of one hand stroke the sole with an up-and-down motion.
9. The heel and ankle are kneaded between the investigator's thumb and forefinger.
10. The massage is finished by holding the foot firmly again with both the investigator's hands.
11. The foot massage is applied to each foot for 5 minutes.

DATA COLLECTION

The study was approved by the Institutional Review Board at Prince of Songkla University and was also granted permission by the hospital. The primary researcher reviewed the patients' medical records and potential subjects were discussed to determine their willingness in participation. Signed informed consent or verbalization of willingness to participate was obtained from the patients or their family members when the patients were unconscious. Privacy of the patients has been maintained.

The primary researcher used two or three days to collect the data for each patient. During daily practice, when it was feasible, the primary researcher tried to assess the pain scores before and during/after invasive painful procedure and also the pain scores before and after pain medication. Moreover, the researcher also assessed the pain scores before and after the foot and hand massage intervention. Data were collected by reviewing medical record, physical examination, observation and interviewing the patients/caregivers.

DATA ANALYSIS

Since invasive procedures can cause pain and pain medication can relieve pain, the primary researcher analyzed the pain scores before and during/after invasive procedure and also the pain scores before and after pain medication to check the applicability and sensitivity of the CPOT. In addition, the researchers compared the pain scores before and after the foot and hand massage intervention to evaluate the effectiveness of the massage intervention.

Results and discussion

General information of the subjects

Patient 1:

History: Female, 67 years old.

On 30/7/2010, had a car accident and severe head injury. E1VtM2, according the Glasgow Coma Scale (E = eye opening; V = verbal response, Vt = intubated; M = motor response), developed subdural hematoma with midline shift 2mm, received decompressive craniotomy immediately. Later, the patient developed hypotension (80/50 mmHg) and was treated with dopamine, E1VtM2, pupils 3mm fixed. On 3/8, CT scan showed large acute subdural hematoma and descending transtentorial herniation. In addition, her blood pressure continued to decrease and finally she developed Multiple Organ Dysfunction Syndrome (MODS). On 5/8, she was dead.

Patient 2:

History: Male, 42 years old.

On 26/7/2010 had a motorcycle accident and suffered moderate head injury and confusion, E2V3M5, pupils 2.5 mm

and both were reactive to light, received craniotomy and was intubated, E2VtM4. On 2/8, the patient developed agitation.

Patient 3:

History: Female, 25 years old.

On 4/8/2010, she had motorcycle accident with moderate head injury, alternation of consciousness, multiple maxillofacial injury, laceration wound and swelling at left cheek, E1V3M5, pupils 4 mm and both were reactive to light, a fracture on right clavicle but no pneumohemothorax. On 10/8, had Operation Reduction Internal Fixation (ORIF) with plate and screw and was unconscious when transferred to the trauma ward from operation room. On 11/8, the patient was conscious.

Patient 4:

History: Male, 26 years old.

On 9/8/2010, he had motorcycle accident, severe head injury, E1VtM6, pupils 3 mm and both were reactive to light, compound depress anterior wall of frontal sinus fracture, maxillofacial injury, right kidney injury at least grade 2-3. On 9/8, he had anterior wall of frontal air sinus decompression and irrigation and had ORIF on maxillary bone.

PATIENT CHARACTERISTICS

The patients' characteristics which are related to this study are summarized and presented in Table 1. Among the four subjects, only patient 1 was elderly. Patient 1 and patient 4 had severe head injury. Patient 1 and 2 got craniotomy and received mechanical ventilator support. With respect to the sedation level, only patient 1 was unarousable/unresponsive and other patients were responsive to the painful invasive procedure. The common nursing problem in these patients was pain. The possible sources of pain were similar in these patients including trauma (e.g. head injury, bone injury, kidney injury), surgery (e.g. craniotomy, ORIF), phlebotomy, dressing change, endotracheal tube, restraint, suction, nasogastric or oral gastric tube, urinary catheter and drainage tube.

Table 1 Patients' Characteristics

Patient / Characteristics		1	2	3	4
Age		67	42	25	26
Gender		Female	Male	Femail	Male
Medical diagnosis		Traumatic subdural hermatoma, severe head injury	Maderate head injury, agitation	Maderate head injury, multiple maxillofacial injuries, clavicle fracture	Severe head injury, compound depress anterior wall or frontal sinus fracture, maxill ofacial injury, right kidney injury
Surgery		Craniotomy on 30/7	Craniotomy on 26/7	ORIF on 10/8	Anterior wall of frontal air sinus decompression and irrigation and ORIF on maxillary bone on 10/8
Level of sedation and consciousness	Day1	Unarousable (-5); E1VtM1	Restless (+1); E4VtM5	Restless (+2) E4V4M5	Restless (+1); E4VtM5
	Day2	Unarousable (-5); E1VtM1	Alert and calm (0) to Restless (+1); E4VtM5	Alert and calm (0); E4V5M6	Alert and calm (0); E4VtM5
	Day3	Unarousable (-5); E1VtM1			
Respiratory support	Day1	POD4: Ventilator	POD9: Ventilator	Operation day: Oxygen mask	Operation day : T-piece
	Day2	POD5: Ventilator	POD10: Ventilator	POD1: Oxygen mask	POD1:T-piece
	Day3	POD6: Ventilator			

Note. ORIF stands for Operation Reduction Internal Fixation; Sedation level was assessed by the Richmond Agitation-Sedation Scale (Sessler, 2002) and consciousness level was assessed by the Glasgow Coma Scale (e.g. E1VtM2 is scored according to E = eye opening; V = verbal response, Vt = intubated; M = motor response); Day 1, 2, and 3 stand for the data collection days; POD = postoperative day (e.g. For patient 1, Day1 and POD4 mean that this was the first day of data collection and also the 4th postoperative day for the patient).

Analysis of the applicability of CPOT for assessing pain

Patient 1: This patient was in deep unconsciousness and unresponsive to any painful stimulus. Therefore, the CPOT could not be used for pain assessment in this patient. However, physiologic data could be used as the pain indicators. Since this patient received continuous dopamine pumping which could influence the blood pressure (BP) and heart rate (HR), the researchers needed to interpret the physiological data carefully. The researcher observed the patient's physiological data one time before suction, and 5 times after suction including the 1st, 2nd, 3rd, 4th, and 5th minute after suction. On day 1 and day 3, the physiologic data (BP, HR) were generally increased immediately after the invasive painful procedure (suction) (Table 2) which is consistent with previous findings that acute pain induces an almost immediate increase in BP and HR (Payen *et al.*, 2001; Puntillo *et al.*, 1997).

Patient 2 : The CPOT could be applied well in this patient for pain assessment since this patient was responsive to the painful invasive procedure. On day 1, the CPOT pain score increased from 2 before suction to 4 during suction. On day 2, the pain score increased from 1 before suction to 5 during suction. These also indicated that suction was a very painful procedure. Therefore, the staff should give patients the prophylactic analgesics before performing the painful treatment to them.

Patient 3 : On day 1, the patient received morphine 3 mg IV at 1:15 pm and the CPOT score decreased from 8 at 1:10 pm to 1 at 1:40 pm. This indicated that the CPOT had high sensitivity to detect the changes in pain sensation since the pain should be less after the patient received pain medication.

Patient 4 : On day 2, the pain score increased from 0 before dressing change to 2 during dressing change. However, three limitations of the CPOT were found in this case. Firstly, the verbal dimension was unobservable since this patient was supported by T-piece rather than ventilator. Secondly, the facial expression dimension was unobservable since this patient's face was covered by the dressing and he also had swelling wound on the eyes. Thirdly, other pain behaviors which are not shown in the CPOT were also observed such as grasping the bed rail and feet and hands clapping the bed during dressing change.

Analysis of the effectiveness of evidence-based foot and hand massage intervention for reducing pain

The primary researcher performed the foot and hand massage to the patients according to the developed protocol. The duration of foot and hand massage lasted for 20 minutes each time.

Patient 1: Since this patient was in deep unconsciousness and had no movement to any painful stimuli, the researchers used the physiologic data rather than the CPOT to evaluate pain. On day 1, the physiologic data showed that the foot and hand massage only slightly reduced the physiologic parameters (Before intervention: BP: 99/53 mmHg, HR: 71/min, RR: 17/min; after intervention: BP: 96/52 mmHg, HR: 72/min, RR: 11/min). This might be due to that the foot and hand massage was less effective in the deeply unresponsive patients. In addition, we assessed pain by using physiologic data;

Table 2 The Changes in the Physiologic Data Before and After Invasive Procedure on Patient

Patient 1	Invasive procedure	Physiologic data before invasive procedure		Physiologic data after invasive procedure				
				1 min	2 min	3 min	4 min	5 min
Day 1	Suction	BP	83/69 mmHg	94/57	89/57	77/66	82/64	85/72
		HR	75/min	74	76	77	77	76
		RR	24/min	23	21	12	20	18
Day 3	Suction	BP	76/58 mmHg	83/62	78/60	77/60	76/58	74/58
		HR	108/min	109	106	107	106	108
		RR	24/min	33	25	15	23	27

Note :- BP stands for blood pressure; HR for heart rate; RR for respiratory rate; 1, 2, 3, 4, 5 min stand for the st, 2nd, 3rd, 4th, and 5th minute after invasive procedure, respectively.

however, this patient received continuous dopamine pumping which could also influence the physiologic data changes.

Patient 2 : On day 1, this patient received both paracetamol 500 mg orally and morphine 3 mg IV at 4:15 am for pain relief. The peak time was 0.5-2 hours for paracetamol and 0.5-1 hour for morphine. However, we assessed pain at 1:50 pm, immediately after performing massage. Therefore, the main outcome of pain score and physiologic data changes was from the massage intervention rather than medication. However, the foot and hand massage was not effective in this patient which was evident from the pain score changes. Before intervention: 3; After intervention: 3 and physiologic data changes, Before intervention: BP: 148/86 mmHg, HR: 90/min, RR: 20/min; After intervention: BP: 159/82 mmHg, HR: 106/min, RR: 20/min). This might be explained by the fact that these patient was agitated and restless which might contribute to the increasing of the BP and HR. In addition, for this patient, the pain might be less on POD9 and the body movements might be the indicator of discomfort rather than pain.

Patient 3 : On day 2, the patient received morphine at 7:02 am. However, we assessed pain at 9:20 am, immediately after performing massage. Therefore, the main outcome of pain score changes was due to massage intervention rather than the morphine effect. The foot and hand massage was very effective to help this patient to control pain by comparing the pain scores before and immediately after massage intervention, 8 and 4, respectively. In addition, since this patient was conscious on day 2 and the patient complained severe pain by self-report before massage, therefore, the CPOT score before massage (8) was consistent with the self-report pain level (severe pain).

Patient 4 : This patient received morphine 3 mg IV at 8:40 am. Considering the peak time of morphine, we assessed pain at 11:30 am, immediately after performing massage; the main outcome of pain score changes was from the massage intervention. The foot and hand massage was effective to reduce pain in this patient by comparing the pain scores before and immediately after intervention, 3 and 2, respectively.

IMPLICATIONS TO CLINICAL PRACTICE

This is a case study report. Although with a sample size of four patients, the degree of representation of our results is limited and future quantitative intervention study is recommended. But the present study still provides some useful information for nursing practice.

Pain in critically ill patients comes from many sources such as trauma, surgery, and invasive painful treatments. Nurses need to minimize the pain sources as much as possible. Preventive approach to relieve pain by administering analgesics is considered as the most effective strategy since the medication acts before the pain becomes severe (Brunner and Suddarth, 2000). The nurses should take proactive measures to ensure that patient does not experience pain rather than relieving pain after it occurred or after getting evidence of pain in the patient (Manias *et al.*, 2005). Therefore, it is recommended that the staff should give patients the prophylactic analgesics before performing the painful treatment to them such as wound dressing, suction and changing position. For the patients who are in deep unconsciousness and are unresponsive to any painful stimulus, the physiologic data become important indicators for pain assessment and nurses can use the immediate change of BP and HR for the evaluation of pain in unresponsive patients. But physiological data are the least sensitive indicators of pain (Pasero, 2009).

The CPOT could be applied well in patients who are responsive to the painful invasive procedure. This tool is able to capture the pain behaviors from facial expression, body movements and muscle tense and verbal dimension. All these behaviors are highly indicative for pain management. This tool also shows good sensitivity. In addition, the CPOT score is consistent with the self-report pain score. However, some limitations of the CPOT are also shown in this study. Firstly, the CPOT cannot be applied in patients who are in deep unconsciousness (e.g. GCS: E1V1M1 or E1VtM1) or deeply unresponsive (e.g. Richmond Agitation-Sedation Scale: unarousable) to the painful invasive procedures. Secondly, the facial dimension is unobservable when the patient's face is covered by dressing or the patient has swelling on the face especially the eyes. Thirdly, for the verbal dimension in the CPOT, the evaluation has two categories. One is compliance with the ventilator (intubated patients), the other is vocalization (extubated patients). However, the verbal dimension is not observable when the patient receives artificial endotracheal tube such as T-piece. Finally, although body movement dimension can represent the main pain behaviors, but some other pain behaviors

which are not included in the CPOT are also observed such as the patient using hand and/or foot to clap the bed and grasping the bed rail. For the foot and hand massage, generally it is effective and easily applied to the critically ill trauma patients. Massaging the feet and hands stimulates the mechanoreceptors that activate the "nonpainful" nerve fibers, preventing pain transmission from reaching consciousness. However, for the patient in deep unconsciousness, the foot and hand massage might be less effective since this kind of patients might have deficit in the sensory transmission function.

CONCLUSION

The CPOT is a useful tool for pain assessment in the case of critically ill patients who are unable to self-report. For the patients in deep unconsciousness or who are largely unresponsive to any painful stimulus, the physiologic data can become useful indicator for pain assessment. The foot and hand massage is effective and is easily applicable to the critically ill patients. Nurses are encouraged to integrate evidence-based nursing interventions into daily pain management regime.

Conflict of interest

There is no conflict of interest.

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