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The Use of a Nurse-Initiated Pain Protocol in the Emergency Department for Patients with Musculoskeletal Injury: A Pre-Post Intervention Study

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ABSTRACT

Background and Aim: As a common complaint of patients with traumatic injuries, pain remains undermanaged in emergency departments (EDs). Our aim was to evaluate the effects of a nurse-initiated pain management protocol in patients with musculoskeletal injuries in an ED in Iran.
Material and Methods: This pre-post intervention design study was conducted on 240 patients with orthopedic injuries selected through sequential sampling over two phases. The intervention consisted of case study sessions and the implementation of the nurse-initiated pain management protocol. The outcomes were assessed based on the Numeric Rating Scale (NRS) pain scores, the pain management satisfaction questionnaire, the nursing performance checklist and the waiting time evaluation form.
Results: The mean pain intensity 30 and 60 min after triage and at discharge decreased significantly in the post-intervention group ($p < .001$). The patients' satisfaction with pain management ($p < .01$) and the nurses' performance ($p < .001$) improved in the post-intervention group. Waiting time: there was a significant reduction in the post-intervention group from the end of triage by the nurse to the visit by the physician, and from patient's arrival in ED to discharge or transferring, and also the time to initial analgesic.
Conclusions: Education based on case study and the implementation of the nurse-initiated pain management protocol resulted in a significant increase in multimodal analgesia administration and a reduction in pain intensity, an increase in patient satisfaction, an improvement in the triage nurses' performance and the reduction of potential delays in pain management while maintaining the safety of patients with musculoskeletal trauma.

In patients with traumatic injuries, the prevalence of pain is as high as 90% (Ridderikhof et al., 2017). Although pain management is an essential part of care in emergency departments (EDs), the undertreatment of pain is common, especially in musculoskeletal injuries (Dale & Bjørnsen, 2015; Ridderikhof et al., 2017).

Research conducted in the United States suggests that more than half of the patients with long-bone fractures do not receive pain medication at EDs (Minick et al., 2012). The results of a study by Alavi et al. in Iran indicated that 60.8% of emergency patients, most of whom had orthopedic injuries, did not receive an intervention for pain relief, and the mean time to initial analgesic was 41 minutes (Alavi, Aboutalebi, & Sadat, 2017). Other studies reported poor pain management at discharge (Awolola, Campbell, & Ross, 2015) and inadequate registration, assessment, reassessment, and pharmacologic and nonpharmacologic pain treatment in the chain of emergency care for orthopedic patients (Berben, Meijs, van Grunsven, Schoonhoven, & van Achterberg, 2012; Scholten et al., 2015).

Acute musculoskeletal pain puts patients at risk of oligoanalgesia (Pierik et al., 2016), and failure to relieve acute pain leads to alterations in immune system functioning (Alavi et al., 2017),

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demoralization, inability to sleep, hopelessness, lack of control, inability to interact with others (Pierik, 2016), and the prolongation of recovery/rehabilitation and delayed wound healing and ultimately results in chronic pain (Scholten et al., 2015) and reduces productivity and quality of life (Pierik et al., 2016).

Another challenge in EDs is the long waiting time for receiving emergency care in the triage unit. In one study conducted in Iran, the waiting time for receiving emergency care was more than 60 minutes (Rahmati, Azmoon, Meibodi, & Zare, 2013). In another study on patients with long-bone fractures, the waiting time to receive analgesia after pain assessment was as long as more than 2 hours (Awolola et al., 2015). The increased waiting time not only increases the patients' dissatisfaction with the health care system but also delays the receiving of services (Mahmoodian, Eqtesadi, & Ghareghani, 2014).

Several obstacles for effective and timely pain management have been studied in EDs. Factors such as inadequate inter- and multidisciplinary interactions, stress or heavy workload, attitude problems, knowledge deficits, misconceptions regarding the need for effective pain management (Pierik et al., 2016), organizational feedback, resistance to using validated pain scales for trauma patients, and reluctance to give intravenous opioids with nurses have been identified (Berben et al., 2012).

The reduction of triage decision-making time (Bambi et al., 2016), pain management, and patient satisfaction with pain management are considered quality indicators in emergency medicine (Dale & Bjørnsen, 2015; Dunne, Jooste, McCabe, & McMahon, 2014). In this context the efficient and rapid management of pain and triage seems to be essential in EDs, especially in patients with musculoskeletal injuries (Barksdale, Hackman, Williams, & Gratton, 2016; Berben et al., 2012; Minick et al., 2012).

Different strategies have been developed in response to inadequate pain management, such as pain management protocols or clinical guidelines and educational interventions for triage staff (Pierik, 2016; Pierik et al., 2016). In one study a reduction in waiting time was found for patients with general musculoskeletal injuries after face-to-face triage with multidisciplinary teams (Joseph, Morrissey, Abdur-Rahman, Hussenbux, & Barton, 2014). In some studies the implementation of pain management protocols by the triage nurse and physician improved the frequency of receiving analgesics and reduced the duration of stay in the ED. Despite these improvements, pain management and timely pain relief remain an issue in EDs (Barksdale et al., 2016; Pierik et al., 2016) and are not in line with the national and local EDs protocols (pharmacologic pain management) that were developed in various institutions and countries (Dale & Bjørnsen, 2015; Newton-Brown, Fitzgerald, & Mitra, 2014; Scholten et al., 2015).

Moreover, evidence suggests that emergency staff often do not have sufficient knowledge about pain management (Dale & Bjørnsen, 2015); as a result, studies recommend the improvement of the triage process by educating triage nurses and implementing a nurse-initiated pain treatment protocol with consideration for the particular care setting and emergency structure in place (Berben et al., 2012; Wong, Chan, & Rainer, 2007). One study found that nurse-initiated protocol for pain management increased patient satisfaction with ED services (Minick et al., 2012). Several countries, such as the Netherlands, Canada, United States, Australia, Sweden, and Hong Kong, have used the nurse-initiated administration strategy for their triage (Muntlin, Carlsson, Säfwenberg, & Gunningberg, 2011; Pierik et al., 2016; Ridderikhof et al., 2017; Wong et al., 2007), but assessing the impact of this practice on important quality indicators of care in EDs in a country like Iran is essential (Alavi et al., 2017; Rahmati et al., 2013).

Iran uses the five-level Emergency Severity Index (ESI) triage. This system does not particularly address triage and optimal pain management for orthopedic/trauma patients (Rahmati et al., 2013). Moreover, no plans have been provided or implemented in Iran for the use of pain management protocols in EDs (Alavi et al., 2017). Other studies on triage examine all the causes of pain cumulatively in different populations, and their methods are heterogeneous and their results inconsistent (Douma, Drake, O'dochartaigh, & Smith, 2016; Ridderikhof et al., 2017). According to the results of one study, education and the implementation of a pain management protocol alone are not sufficient for improving pain management and reducing the duration of stay in EDs (Ridderikhof et al., 2017). Additionally, the current pain management system used in trauma patients varies throughout the chain of emergency care and deviates from the evidence-based guideline "(non-)pharmacological pain treatment" recommendations (Scholten et al., 2015).

Based on the review of literature on the long waiting time and inadequate pain management in EDs, which is often a result derived from observational studies and the assessment of nursing and physician documentation and checking patients' charts (Dale & Bjørnsen, 2015; Newton-Brown et al., 2014), and given the need to improve triage processes, the present study was conducted to determine the effect of a nurse-initiated pain management protocol on triage performance, waiting time, and pain management of patients with musculoskeletal injuries in an ED in Iran.

Methods

Study Design

This was a pre-post intervention design study.

Participants and Setting

The patients visiting the trauma center/ED of Shohada Hospital in Khorramabad (the capital city of Lorestan Province in the west of Iran) from January to July 2016 with bone fractures in the limbs and minor soft tissue injuries were selected through sequential sampling. In addition, all the nurses working at the triage unit during the mentioned period were also included in the study using sequential sampling. The sample size for the patients was determined as 260 based on a review of literature and considering the average number of triaged orthopedic injuries (3-4 patients) by the nurse in each work shift in Iran, as well as the 75% prevalence of pain in EDs, (Alavi et al., 2017), the confidence level of 90%, and the error rate of 5%.

At the time of the study, the examined trauma center had 39 beds, 49 nurses with bachelor of science (B.Sc.) degrees, 15 general practitioners, and 4 emergency medical specialists. The nurses had not previously attended any formal educational courses on orthopedic patients' triage or pain management. Around 54,000 patients with orthopedic and other injuries were admitted and assessed in the triage unit anually. This center serves as a referral center for neighboring cities and covers a population of about 2 million. The triage unit was located at the entrance of the ED, and the ED nurses did not directly communicate with prehospital staff. The triage unit was connected to the emergency medical services (EMS) through an ED supervisor nurse in each shift (via the dedicated phone line).

The inclusion criteria for the patients consisted of age 18-65; single short- and long-bone fractures, soft tissue injuries (including bruises and strains), or lacerations; triage acuity level 3 or 4; and acute pain (starting from 6 hours before). The inclusion criteria for the nurses included a B.Sc. or master of science (M.Sc.) degree in nursing and work experience in the triage unit for at least 3 months. The exclusion criteria for the patients consisted of cognitive impairment and mental illness, unstable hemodynamic

status, a history of substance abuse or dementia, advanced hepatic disease, chronic pain syndromes or previous treatment with an analgesic for the same injury, active hemorrhage, signs and symptoms of compartment syndrome, the lack of distal pulse, complete or partial loss of the limbs, a mechanism of trauma with a bullet hit to the groin (triage acuity level 2), abdominal pain and severe head injury along with orthopedic injuries, pregnancy, daily use of pain medications or suffering from chronic pain, allergies to the medications used in the study, and reluctance to continue participation in the study. The exclusion criteria for the nurses included absence from one session of the training program and participation in other emergency care training programs during the study.

Ethical Considerations

The present study was approved by the Ethics Committee of Lorestan University of Medical Sciences (No. LUMS.REC.1394.39). We obtained the ethical committee approval to conduct this study according to the Helsinki Declaration. Also every patient and nurse participant to this study signed a consent form.

Intervention

The study was performed in three phases: preintervention, intervention, and postintervention.

Preintervention

After obtaining permission from the hospital management and emergency department and informing the triage staff of the study objectives, the observer visited the ED. First, using the triage nurses' performance assessment checklist, the performance of the triage nurses was evaluated in three areas—namely, primary assessment, orthopedic (secondary) assessment, and pain management in eligible orthopedic patients in the morning and evening shifts from 9 a.m. to 9 p.m. over a month (January 1-30, 2016) using collaborative observation (Polit & Beck, 2004). Considering that the 40 nurses participating in the study were working in the triage unit, each nurse was given a specific code or number, and the performance of each nurse was observed and evaluated in the triage of three patients with triage acuity levels 3 and 4, making for a total of 120 patients (60 patients at level 3 and 60 at level 4). In addition, for the patients in relation to whom the nurse's triage performance was observed and assessed, the observer recorded the waiting time in minutes and seconds using a Casio chronometer calibrated daily during the research with two similar chronometers. The waiting times measured included the time of the patient's arrival to the ED, the waiting time for visit by the triage nurse, the waiting time for visit by the physician, the time to initial analgesic, and the waiting time until the right course of action (decision making for discharge or transfer to others wards for inpatients cases) was determined for the patient in the ED.

At the beginning of the triage, the patients' triage acuity level according to the ESI triage was unclear, therefore the observer completed the nursing performance checklist and the waiting time evaluation form for each and every one of the orthopedic patients who presented to the ED. After the nurse had determined the patients' triage acuity level, a number of patients were randomly selected from each triage level to complete the nursing performance checklist and the waiting time evaluation form. Because the evaluation (observing the nurses' performance and the patients' waiting time) was performed on orthopedic patients with triage levels 3 and 4, 60 patients were selected from level 3 triage cases and 60 patients from level 4 triage cases. Overall, the nursing performance checklist and the waiting time evaluation form were completed for 380 patients; however, according to the inclusion criteria for the patients and the sample size, the nursing performance checklist and the waiting time evaluation form were completed for 120 patients in the preintervention phase. Finally, after the right course of action was determined for the patients in the ED, the pain management satisfaction questionnaire and the Numeric Rating Scale (NRS) for pain were distributed among the same patients with triage levels 3 and 4 selected in the previous phase, and they were briefed on the study objectives and then asked to determine their pain score and complete the pain management satisfaction questionnaire in a quiet place before leaving the ED.

In the preintervention stage, the patients received routine triage care based on the ESI, including general assessment and the determination of resources by the nurse and physician and care for the wound and limb immobilization by the nurse. The research assistant, as the observer and collector of the other data, had a B.Sc. degree in nursing and was working as a nurse in the same trauma center and was therefore well known to the trauma center staff, and all the observations and assessments of the indicators under study at the pre- and postintervention stages were carried out by the same trained person. The research assistant played no part in triage assessment, decisions, or care.

Intervention Phase

The intervention phase had two parts: Educating the triage nurses and implementing the nurse-initiated pain management protocol for orthopedic patients.

Education Sessions for the Nurses

One week after the first phase of the study, all 49 nurses in the ED were invited to participate in the study, and 40 of them agreed to participate. The training intervention for triage nurses was held by the first researcher (an expert in emergency care) and an emergency medical specialist in three weekly 90-minutes sessions in the ED's conference room over 3 weeks; they used face-to-face case-based learning in small groups of 4-5 people in the morning or evening shifts. The first session presented the general objective of the training and the objectives of each session, the educational content, the principles of case-based learning, the learners' tasks and the expectations from them in this method (Popil, 2011), the principles and significance of triage, and the primary and secondary stages of orthopedic assessment. A week later, in the second session, the ESI algorithm and the nurse-initiated pain management protocol in orthopedic injuries and its means of implementation were presented to the nurses through lectures, two paper-based scenarios for triage were presented at different levels, and the nurses then discussed and determined the triage level and the means of pain management in the given scenarios. At the end of the second session, a booklet containing the principles of triage based on the ESI (Gilboy, Tanabe, Travers, & Rosenau, 2012), the means of the professional assessment of musculoskeletal injuries, and the pain management algorithm and four scenarios were distributed among the nurses; they were given 1 week to answer four-choice questions related to each scenario in a group and present their answers in the third or final session. In the third session, participants' responses to the scenarios were presented and discussed in relation to how they solved the issues raised in the scenarios and the barriers and facilitators of pain assessment and management in orthopedic patients. The scenarios were designed by the first researcher, and their content validity was determined by the

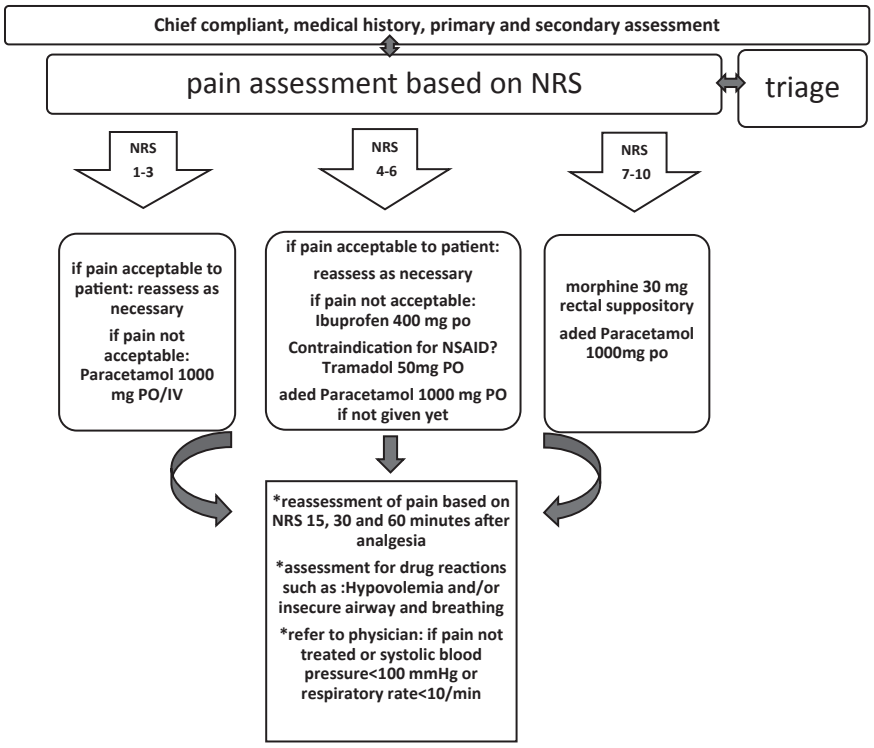

Figure 1. Algorithm for the nurse-initiated pain protocol in the emergency department. NRS = Numeric Rating Scale; PO = orally; IV = intravenously; NSAID = nonsteroidal anti-inflammatory.

research team. An example of one case scenario is presented in Appendix A.

Pain Management Protocol Implementation

The pain management protocol was designed (Fig. 1) based on the review of literature and national and international pain management protocols (Berben, Kemps, Mintjes-de, & Schoonhoven, 2011; Pierik et al., 2016; Ridderikhof et al., 2017; Wong et al., 2007) and after several specialists, including a triage nurse, two nurses specializing in pain management and emergency care, and one emergency physician, determined its validity in terms of relevance and clinical applicability. The major change in this protocol was that the nurse was allowed to autonomously administer analgesics to the patient without the patient being first assessed by a physician. Paracetamol was the first choice of treatment, and if needed, nonsteroidal anti-inflammatory drugs and morphine rectal suppositories were also administered. According to this protocol, the nurses were required to record and assess the pain during the administration of analgesia and to reasses it 15 minutes, 30 minutes, and 1 hour after administrating the analgesia. The nurses had used no standardized pain protocols before and during the study. There was also no structural measurement (e.g., NRS) and registration of pain score by the nurses in this period.

Two weeks after the end of the training intervention, the implementation of the triage pain management protocol began for orthopedic patients with triage levels 3 and 4 as follows. On the patient's arrival in the triage unit, a triage nurse assessed the main complaint and made the primary and secondary assessments, took the patient's medical history and their allergy and medication background, checked their vital signs, and performed a pain assessment using the NRS, which was color coded on A4 paper. After determining the pain score, and based on the new pain management protocol, analgesics were administered for the patients by the nurse according to the algorithm. After administering the medications based on the administration method and pain intensity, the nurse reassessed the patient's pain, and if the pain had not been managed (i.e., a pain score greater than 4) or there were adverse side effects and reactions to the analgesics, the appropriate decision regarding the readministration of the analgesic or its discontinuation was made through consultation with an emergency physician. For the patients with known allergies to pain medications, the researchers consulted with a physician about an alternative medication. Oral analgesics were administered with the expectation that the patient would not vomit and would tolerate the oral route.

This protocol was implemented over 2 months to manage the pain of adult patients with musculoskeletal injuries and pain admitted to the triage unit. Before implementation, permission was obtained from the hospital managers and emergency physicians to get the protcol implemented by a nurse.

To facilitate learning and implementation, a 90-cm × 70-cm color poster of the nurse-initiated pain management protocol algorithm was fitted on a suitable board in the triage nurses' station in the ED as a reminder for the nurses.

Postintervention Phase

Two months after the implementation of the pain management protocol, the reassessment of outcomes for orthopedic patients and triage nurses who met the inclusion and exclusion criteria was carried out once again as described in the preintervention phase. This phase lasted from early to late June and evaluated triage nurses' performance and the patients' waiting time in 420 cases of musculoskeletal injuries. The nursing performance checklist, the waiting time evaluation form, the NRS, and the pain management satisfaction questionnaire were completed in the postintervention phase for 120 patients as the treatment group based on the patients' eligibility criteria. The nurses participating in the

postintervention phase (n = 40) were the same nurses who had participated in the preintervention phase of the study.

Measures

The tools used for assessing the study variables had five parts: (1) the personal information form; (2) triage nurses' performance; (3) waiting time; (4) patient satisfaction with pain management; and (5) pain assessment and reassessment. The personal information form for patients included seven items on age, gender, mechanism of trauma, injury type, adverse effects, and the administration of pharmacologic and nonpharmacologic treatments. Additional data were extracted from the patient registration system (i.e. the patients' electronic health records) at the ED. The personal information form for nurses included items on age, gender, education, and work experience in the ED.

Triage Nurses' Performance

The Triage Nurses' Performance Checklist was designed based on the research team's review of literature and in view of nurses' role in the triage process for orthopedic patients (Bambi et al., 2016; Fuentes-Losada, Vergara-Amador, & Laverde-Cortina, 2016; Jelinek, Fahje, Immermann, & Elsbernd, 2014; Newton-Brown et al., 2014; Scholten et al., 2015). This 29-item checklist assessed three subscales in orthopedic patients, including primary patient assessment (18 items), orthopedic assessment (two items), and pain management (nine items: administering analgesia and recording their administration; assessing and recording pain in the triage; reassessing and recording pain 15, 30, and 60 minutes after analgesia administration; assessing the adverse effects of the medications; and assessing the patient's comfort with the pain management methods used). The questions were answered with "yes" and "no." A score of 0 was given for the answer "no" and 1 for the answer "yes," and the total score was recorded as the final score. The minimum score was 0 and the maximum score was 29. A higher score indicated the nurse's better performance. To determine the content validity, the tool was presented to 10 nursing faculty members and emergency medical specialists and was used after applying their comments. After determining its content validity and before its use in this study, the reliability of the checklist was determined using the interrater reliability method to prevent observer bias in recording the data. For this purpose, the researcher, a triage nurse, and an emergency physician (trained to complete the time evaluation and ESI triage forms) completed the forms for 20 triaged patients. The correlation assessment led to an interrater κ coefficient of 0.84 ($p < .001$) and confirmed the reliability of the tool. To increase this reliability, the nurses' performances during the study were observed entirely by a single observer. The triage nurses' practice for patients with musculoskeletal injuries is illustrated in Figure 2.

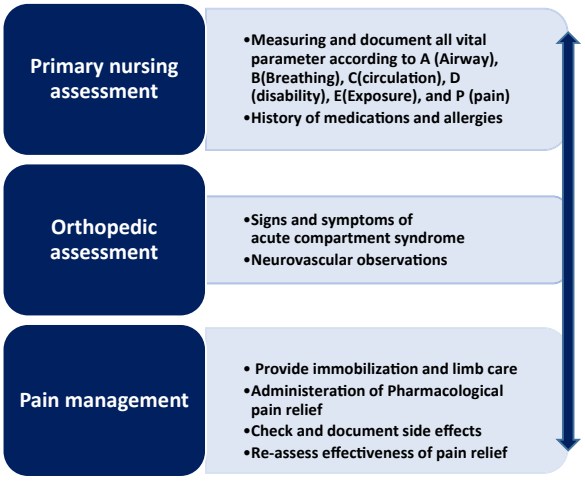

Figure 2. The performance of nurse in triage of patients with musculoskeletal injuries.

Waiting Time

The observer recorded the time of the patient's arrival in the ED until the right course of action for the patient was determined using a chronometer in one shift. The recorded times consisted of the time from the patient's arrival in the triage room until the end of triage by the nurse, the end of triage by the nurse until the physician's visit, and the patient's arrival to the ED until the right course of action was determined (discharge, transfer, admission, or departure to/from the ED).

Patient Satisfaction with Pain Management

The pain and patient satisfaction questionnaire had 12 items (Phillips, Gift, Gelot, Duong, & Tapp, 2013) and was adapted from the American Pain Society's Patient Outcome Questionnaire and the Patient Opinion of Pain Management Tool (Max et al., 1995; Phillips, Gift, Gelot, Duong, & Tapp, 2013). This questionnaire was designed to assess the patients' personal information (items 1-4), different aspects of pain intensity (items 5-7), and satisfaction with pain management (items 8-12). The present study only used items 8-12 of this questionnaire to assess "the patient satisfaction with pain management by the nurse." The score given ranged from 1 ("very dissatisfied") to 6 ("very satisfied") on the Likert scale. The minimum score was 5 and the maximum was 30, and higher scores indicated the patients' higher satisfaction with the nurses' responsiveness to their pain and their better management of it. The tool was presented to 10 nursing faculty members and emergency medical specialists to determine its content validity and was used after applying their comments. A test-retest was used to determine the reliability of the tool ($r = 0.86$).

Pain Assessment and Reassessment

The structured questionnaire consisted of (1) pain assessment, including the recording of the NRS measurements at triage and 5, 15, and 60 minutes after pain medication administration and at discharge; (2) time to initial analgesic; and (3) types of adverse events, if any (according to the findings). The NRS was validated for determining acute pain in EDs (Pierik et al., 2016). The patients were asked to assess their pain intensity on a scale from 0 ("no pain") to 10 ("the worst pain imaginable"). Scores of 0 ("no pain") to 4 were taken as mild pain, 4-6 as moderate pain, and 7-10 as severe pain.

To minimize contamination of the pretest-posttest design, the preintervention data were collected over 1 month (June 1-30, 2016). The pain management protocol was introduced (July 1 to mid-August), and then 2 months after the implementation of the protocol, the posttest data were collected (November 1-30, 2016) (Fig. 3).

Data Analysis

The data were analyzed by SPSS version 16 (SPSS Inc., Chicago, IL, USA), as a *t* test to evaluate the effect of intervention on wait time and performance in experimental versus control groups. A Mann-Whitney test was used to compare patients' satisfaction to test the effect of triage in two different groups. Visual analog scale scores as continuous variables were presented as means (standard deviation) and compared using the independent sample *t* test. Ordinal variables were analyzed using the Mann-Whitney test and

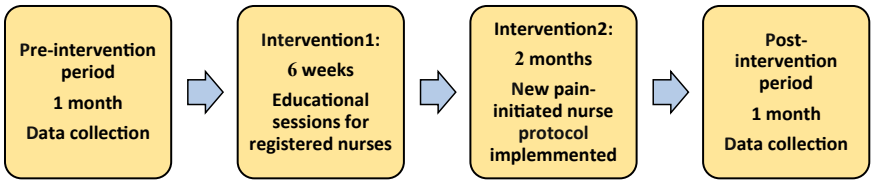

Figure 3. Study timeline.

the Kruskal-Wallis test, and a χ^2 test was used to compare binary variables. Statistical significance was set at $p < .05$ (two tailed).

Results

Patients' Characteristics

A total of 120 patients completed the study in the pre-intervention phase and 120 patients in the postintervention. Of these 240 patients, the majority were male (68.3%) and their mean age was 34.4 years. The sociodemographic characteristics of the patients are listed in Table 1. In both phases of the study, the patients were similar in terms of age, gender, mechanism of injury, and initial pain score (Table 1).

Nurses' Characteristics

A total of 40 nurses participated in the study, and none of them were excluded from the study in the pre- or postintervention phases. The mean work experience of the nurses in the ED was 3.6 years (range 1-16). In addition, the average age of nurses was 31.40 years and 53% were male.

Mean Pain Intensity and Satisfaction with Pain Management

The findings indicated that pain intensity was severe at the time of entering triage, and there was no difference in pain levels between the preintervention and postintervention groups in triage or 15 minutes after triage; however, pain levels decreased significantly in the postintervention group compared with the pre-intervention group 30 and 60 minutes after triage and at discharge ($p < .001$) (Table 2). Considering that 75.8% of the patients in the postintervention group received pharmacologic treatment in the first hour, the pain management accomplished in the post-intervention group could be due to the nurses' compliance with the pharmacologic pain management protocol. The use of pharmacologic treatment in the preintervention phase was 20% and reached 75.8% in the postintervention phase (Table 1). The patients were not satisfied with their pain management in the preintervention phase, but there was a significant satisfaction with the pain management received in the postintervention group ($p < .01$). None of the patients (postintervention group) reported any adverse effects for the medications (Table 1).

Nurses' Performance in Primary Assessment, Orthopedic Assessment and Pain Management

The triage nurses' performance was poor in the pre-intervention group in terms of primary and orthopedic assessments, but their

Table 1
Baseline Characteristics of the Pre- and Postintervention Groups

Participant Characteristics (N = 240)			
Variables	Preintervention Group, Pretest (n = 120)	Postintervention Group, Pretest (n = 120)	*p*
Sex			
Male	78 (65)	86 (71.7)	.17
Female	42 (35)	34 (28.3)	.22
Mean age, y (SD)	34 (21)	36 (23)	.19
Mechanism of injury (n, %)			
Accidents	40 (33.3)	38 (31.6)	.28
Fall	34 (28.3)	37 (30.8)	.36
Sports	14 (11.6)	12 (10)	.18
work	14 (11.6)	20 (16.6)	.21
violence	10 (8.3)	8 (6.6)	.64
others	8 (6.6)	5 (4.2)	.58
Injury type			
Fracture	68 (56.6)	61 (50.8)	.77
Dislocation/luxation	16 (13.3)	22 (18.3)	.49
Sprains & strains	19 (15.8)	21 (17.5)	.36
Contusion	13 (10.8)	15 (12.5)	.18
Other	4 (3.3)	1 (0.83)	.84
Received analgesics, n (%)	24 (20)	91 (75.8)	<.001*
Received nonpharmacologic pain interventions (immobilization, compression), n (%)	46 (38.3)	68 (56.6)	.021
Received analgesic and nonpharmacologic pain interventions, n (%)	34 (28.3)	96 (80)	<.001*
Adverse effects (e.g., hypotension), n (%)	1 (83)	0	.022

SD = standard deviation.
* $p < .05$.

Table 2
Comparison of Pain Intensity and Satisfaction of Pain Management in Pre- and Postintervention Groups

Variables	Preintervention Group, Pretest (n = 120), Mean ± SD	Postintervention Group, Posttest (n = 120), Mean ± SD	Intervention Effect, *p*
Pain intensity at triage	7.68 (1.54)	8.10 (1.24)	.77
Pain intensity at 15 min	7.12 (1.17)	6.67 (1.58)	.21
Pain intensity at 30 min	6.65 (1.14)	3.86 (1.63)	<.001*
Pain intensity at 60 min	6.1 (1.19)	1.16 (1.51)	<.001*
Pain intensity at discharge	5.9 (1.11)	1.24 (1.36)	<.001*
Satisfaction of pain management	−5.69 (4.49)	8.24 (2.48)	.01*

SD = standard deviation.
* $p < .05$.

performance improved in the post-intervention group ($p < .001$). In addition, the nurses' performance in pain management, including pain assessment and reassessment, timely administration of analgesia, and recording the pain score, improved significantly in the postintervention group compared with the preintervention group ($p < .001$; Table 3).

Waiting Time

The time from arrival of the patient to the ED until the end of triage by the nurse was longer in the postintervention group than in the preintervention group, and the mean time almost doubled (from 0.5 to 1.2) ($p < .001$). Nonetheless, the waiting time from the end of triage by the nurse to visit by the physician and also from the arrival of the patient to the ED until the right course of action (discharge or transfer from the ED) was determined decreased significantly in the postintervention group compared with the preintervention group. The mean time to initial analgesic decreased from 64 minutes in the preintervention group to 22 minutes in the postintervention group (Table 4).

Discussion

The present findings indicate how a nursing intervention with a multimodal analgesia management approach increases the frequency of analgesic administration and reduces pain intensity, especially at discharge, and can improve other quality indicators of pain management and care in the ED in orthopedic patients, including pain assessment and reassessment, assessment focused on orthopedics, time to initial analgesic, duration of stay in the ED, and satisfaction with pain management.

Pain Relief

In the preintervention phase the frequency of registration and the pain assessment and reassessment had poor scores, and these results were consistent with the results of a study in the United States (Muntlin et al., 2011). A significant improvement was identified in these variables in the postintervention phase, and the pain intensity also decreased significantly 30 and 60 minutes after triage and at discharge. These findings could be the result of using a structured nursing assessment and persistence in nursing decision making for the administration of proper analgesics to patients. In a study by Pierik et al. (2016), the nurse-initiated protocol improved the mean pain reduction from 1.00 to 1.56 points the on NRS in patients with severe and moderate pain. In the cited study the mean relief reached as high as > 2.02 points in the patients who received analgesia (Pierik et al., 2016). In the present study the pain intensity at discharge decreased significantly in the post-intervention group compared with the preintervention group. Because achieving a statistically significant difference in the mean pain relief is often dependent on the sample size, it is necessary to know that the difference reported in the present study is clinically relevant. A pain relief of 2 points on the NRS or a 33% reduction in pain are defined as clinically significant changes (Pierik, 2016).

Administration Frequency and Analgesic Safety

In a study by Muntlin et al. (2011), a nursing assessment and the implementation of the nurse-initiated intravenous opioid analgesic protocol led to a significant improvement in the frequency of receiving analgesics and a reduction in the time of analgesic administration. In a study in Switzerland, an increase was reported in analgesic administration from 40% to 63% in cases of severe pain for any reason (Decosterd et al., 2007). The multifaceted implementation of evidence-based education and educational and awareness strategies (staff and managers) also led to a significant improvement in the use of nerve blocks as a mode of analgesia for elderly patients with fractured neck of femur presenting to the ED (Newton-Brown et al., 2014). It can, however, be argued that the frequency of administration does not reflect the adequacy of pain management, and other issues such as the actual administration of analgesics, safety, and the standard dosage for effective pain management should also be taken into account.

The intervention given in the present study seems to be well tolerated and without side effects. In a study by Goh et al., no adverse side effects were identified in patients who received intramuscular ketorolac from the triage nurses (Goh, Choo, Lee, & Tham, 2007). Nonetheless, because the occurrence of serious opioid-related adverse events is relatively low, the incidence,

Table 3
Comparison of Performance of Triage Nurses in Pre- and Postintervention Groups

Variables	Preintervention Group, Pretest (n = 12), Mean ± SD	Postintervention Group, Posttest (n = 120), Mean ± SD	*p*
Primary assessment	0.5 (1.54)	12.20 (3.87)	<.001*
Orthopedic assessment	0.2 (0.25)	1.98 (0.18)	<.001*
Pain management (including administration of analgesia; assessment, reassessment, and documentation of pain at triage, 15, 30, and 60 min after triage)	0.03 (0.22)	7.86 (0.77)	<.001*

SD = standard deviation.
* $p < .05$.

Table 4
Comparison of Triage Time Intervals and Waiting Time to Initial Analgesia in Pre- and Postintervention Groups

Variables	Preintervention Group, Pretest (n = 120)		Postintervention Group, Posttest (n = 120)		
	Mean ± SD (Min)	Median (Min)	Mean ± SD (Min)	Median (Range) (Min)	*p*
Waiting time from patient's arrival in ED to end of triage by nurse	0.60 (0.51)	0.5 (0.1-2)	1.15 (0.33)	1.20 (1-3.20)	<.001*
Waiting time from end of triage by nurse to doctor's visit	6.26 (3.07)	6 (4.50-10.20)	5.63 (3.36)	5 (4-12.50)	.01*
Waiting time from patient's arrival in ED to decision making for discharge or transfer to others wards	78.97 (36.18)	77 (56.20-100)	62.50 (15.26)	62 (54-92.30)	<.001*
Waiting time to initial analgesia	64	60 (21-106)	22	18 (10-62)	<.001*

SD = standard deviation; ED = emergency department.
* $p < .05$.

although low, of severe side effects cannot be completely ruled out based on the study's sample size.

Patient Satisfaction with Pain Management

Patient satisfaction with pain management leads to better involvement in decision-making processes and increases their understanding of the provided education (Joseph et al., 2014). Nonetheless, evidence suggests that health care professionals' responsiveness in terms of acute pain management in the ED is suboptimal, which means that many patients remain in a distressed condition and dissatisfied with care (Dunne et al., 2014). A face-to-face multidisciplinary triage with a defined role for the physiotherapist and trauma nurse expert can lead to increased levels of satisfaction in musculoskeletal patients (Joseph et al., 2014). Patient satisfaction can be affected by quality improvement processes, such as the implementation of pain management protocols. In the study by Muntlin et al. (2011), the nurse-initiated intravenous analgesic protocol for abdominal pain led to an increase in patient satisfaction with the quality of care in pain management in the ED. The authors attributed the successful improvement of the quality of care to the use of the facilitative approach called the translation of research into practice (Muntlin et al., 2011).

Comprehensive Assessment

Another important finding was the almost comprehensive assessment of the patients that improved significantly after the intervention. One study found that implementing a standardized triage system increased the use of vital parameters and signs and symptoms for decision making (Vatnøy, Fossum, Smith, & Slettebø, 2013). Some studies have noted that, as a single initiative, guidelines and protocols have little effect on improving pain management. According to these studies, the first step in improving pain assessment and management in EDs is to systematically and accurately assess each patient (Dale & Bjørnsen, 2015). In the systematic assessment of patients, simultaneous attention is paid to pain (Fuentes-Losada et al., 2016) and physiologic and vital parameters such as the airways, blood circulation, respiration, and the lack of consciousness (Vatnøy et al., 2013), and this kind of assessment becomes the basis for decision making in nursing practice, increases accuracy in triage, and prevents the overtriage or undertriage of patients (Patrick, Rosenthal, Iezzi, & Brand, 2015; Vatnøy et al., 2013). The pain management protocol can increase pain awareness by incorporating a regular pain assessment routine in adult patients with traumatic injuries (Ridderikhof et al., 2017).

Process Triage Time in Relation to Pain Management

Related studies indicate that patients' satisfaction with emergency services is improved by reducing waiting time (Davaraani, Doroudgar, Nejati, & Sharifipour, 2014). Other evidence suggests that pain protocols reduce the duration of stay in the ED, especially in patients with moderate pain (Pierik et al., 2016). In addition, in a Canadian study, a reduced time for administering analgesics was associated with a shorter duration of stay in the ED (Sokoloff, Daoust, Paquet, & Chauny, 2014).

In one study the use of an emergency triage nurse–initiated pain management protocol was compared with analgesic administration by ED physicians for patients with isolated limb injury. The mean time interval for analgesic administration was 2.5 minutes for the triage nurses and significantly longer, 68.2 minutes, for the physicians (Goh et al., 2007). In another study the implementation of the nurse-initiated protocol led to an average reduction of 68 minutes in the time from the initial assessment to the administration of analgesia (Patrick et al., 2015). The College of Emergency Medicine (CEM, 2010) has suggested that 98% of patients with severe pain (7-10 on the pain scale) should receive or be offered an analgesia within 60 minutes of their arrival, and 90% of the patients with moderate pain (4-6 on the pain scale) should also receive or be offered an analgesia within 60 minutes of their arrival (Dunne et al., 2014).

Limitations and Strengths

The present study is one of the first in Iran to examine the administration of multimodal analgesics, especially using morphine, as a standing order carried out autonomously by nurses. Traditionally the precarious issue is the fear of masking symptoms leading to misdiagnosis when administering opioids. In a Cochrane review the authors conclude that opioid use before the physician's assessment does not increase the risk of misdiagnosis in patients with acute abdominal pain, and these results can possibly be generalized to patients with musculoskeletal injuries as well (Manterola et al., 2007; Ridderikhof et al., 2017). Another strength of the present study was the assessment and reassessment of acute pain at different times using the patients' self-reported pain intensity scale rather than the documentation of pain scores by the nurses. Acute pain has a dynamic nature and frequent pain assessment is necessary for adjustment to the dose of analgesics or multimodal analgesic treatment strategies.

One limitation of the study was that the analgesics used in prehospital care could have affected the results, and the researcher did not take this limitation into account. There were some limitations in the study design as well. One was the possibility of reversing behaviors, but the use of an external monitor guaranteed the quality assurance of the study (Muntlin et al., 2011). The clinical

trial design is the best option for studying the effect of interventions, but such a study design was not possible in this case for financial and practical reasons. There were also many confounding variables, such as the severity of the injury and the knowledge and experience of the nurses, which were difficult to control. Because of the presence of the observer, the Hawthorne effect was also possible. Although the study protocol was tested for face validity before being used and although it was easy to use for the nurses, the development of the protocol in the present study was mostly based on other countries' protocols, such as that of the Netherlands; local and national protocols are therefore recommended to be used (Dale & Bjørnsen, 2015).

Conclusions

Education based on case-based learning about pain management for clinical staff and the implementation of the nurse-initiated pain management protocol in the ED resulted in a significant increase in multimodal analgesia administration and a reduction of pain intensity, increased patient satisfaction, improved nurses' performance, and a reduction of potential delays in pain management while maintaining safety in the triage of patients with musculoskeletal injuries. In addition, to improve pain assessment and management in ED patients, a local framework focused on knowledge, communication, emergency organization, and patient flow should be developed and established. This approach requires a change in health care professionals' attitude and continuous evaluation and feedback (Dale & Bjørnsen, 2015).

Relevance to Clinical Practice

In patients with acute musculoskeletal injuries, the adherence to the nurse-initiated pain protocol, especially in terms of administration of opioid analgesics as a standing order and reassessment of pain by triage nursing staff, may be useful to optimize acute pain management and triage timing. Inadequate management of acute pain has been associated with the development a complex pattern of disability and chronic pain (Awolola et al., 2015). Emergency nurses have a significant responsibility for acute pain management, so there are needs for further education such as action learning on efficient analgesic practices.

The application of an audit intervention or reaudit process to the clinical review of pain management in patients with musculoskeletal injuries facilitated change to emergency care. To improve pain management in the chain of emergency care (emergency medical services, helicopter emergency medical services, and ED), future studies are recommended to develop, implement, and test a guideline based on national evidence, especially for pain management in children, musculoskeletal patients, cardiac patients, and the elderly, that takes the chain of emergency medical services into account as well.

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Supplementary Data

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References

Alavi, N. M., Aboutalebi, M. S., & Sadat, Z. (2017). Pain management of trauma patients in the emergency department: a study in a public hospital in Iran. *International Emergency Nursing, 33*, 53–58.

Awolola, A. M., Campbell, L., & Ross, A. (2015). Pain management in patients with long-bone fractures in a district hospital in KwaZulu-Natal, South Africa. *African Journal of Primary Health Care & Family Medicine, 7*(1), 1–5.

Bambi, S., Ruggeri, M., Sansolino, S., Gabellieri, M., Tellini, S., Giusti, M., Ciulli, E., Franchi, F., Petrocchi, L., Olivi, M., Gravili, R. C., Biancalana, P., Millanti, A., Martini, L., & Sgrevi, P. (2016). Emergency department triage performance timing. A regional multicenter descriptive study in Italy. *International Emergency Nursing, 29*, 32–37.

Barksdale, A. N., Hackman, J. L., Williams, K., & Gratton, M. C. (2016). ED triage pain protocol reduces time to receiving analgesics in patients with painful conditions. *The American Journal of Emergency Medicine, 34*(12), 2362–2366.

Berben, S. A., Kemps, H. H., Mintjes-de Groot, J. A., & Schoonhoven, L. (2011). Guideline 'Pain management for trauma patients in the chain of emergency care.'. *Nederlands Tijdschrift Voor Geneeskunde, 155*(18), A3100.

Berben, S. A., Meijs, T. H., van Grunsven, P. M., Pierre, M., Schoonhoven, L., & van Achterberg, T. (2012). Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury, 43*(9), 1397–1402.

Dale, J., & Bjørnsen, L. P. (2015). Assessment of pain in a Norwegian Emergency Department. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 23*(1), 86.

Davaraani, S. S., Doroudgar, A., Nejati, A., & Sharifipour, E. (2014). Efficacy of acute pain control protocol in triage department on analgesics administration time and patients' satisfaction. *Advances in Biosciences & Clinical Medicine, 2*(2), 71.

Decosterd, I., Hugli, O., Tamchès, E., Blanc, C., Mouhsine, E., Givel, J.-C., Yersin, B., & Buclin, T. (2007). Oligoanalgesia in the emergency department: short-term beneficial effects of an education program on acute pain. *Annals of Emergency Medicine, 50*, 462–471.

Douma, M. J., Drake, C. A., O'dochartaigh, D., & Smith, K. E. (2016). A pragmatic randomized evaluation of a nurse-initiated protocol to improve timeliness of care in an urban emergency department. *Annals of Emergency Medicine, 68*(5), 546–552.

Dunne, G., Jooste, R., McCabe, C., & McMahon, G. (2014). The use of action learning as a strategy for improving pain management in the emergency department. *International Emergency Nursing, 22*(3), 172.

Fuentes-Losada, L. M., Vergara-Amador, E., & Laverde-Cortina, R. (2016). Pain management assessment in children with limb fractures in an emergency service. *Revista Colombiana de Anestesiología, 44*(4), 305–310.

Gilboy, N., Tanabe, P., Travers, D., & Rosenau, A. M. (2012). *Emergency Severity Index (ESI): a triage tool for emergency department care, version 4*. Implementation Handbook, 12-0014.

Goh, H. K., Choo, S. E., Lee, I., & Tham, K. Y. (2007). Emergency department triage nurse initiated pain management. *Hong Kong Journal of Emergency Medicine, 14*(1), 16–21.

Jelinek, L., Fahje, C., Immermann, C., & Elsbernd, T. (2014). The trauma report nurse: a trauma triage process improvement project. *Journal of Emergency Nursing, 40*(5), e111–e117.

Joseph, C., Morrissey, D., Abdur-Rahman, M., Hussenbux, A., & Barton, C. (2014). Musculoskeletal triage: a mixed methods study, integrating systematic review with expert and patient perspectives. *Physiotherapy, 100*(4), 277–289.

Mahmoodian, F., Eqtesadi, R., & Ghareghani, A. (2014). Waiting times in emergency department after using the emergency severity index triage tool. *Archives of Trauma Research, 3*(4), e19507.

Manterola, C., Astudillo, P., Losada, H., Pineda, V., Sanhueza, A., & Vial, M. (2007). Analgesia in patients with acute abdominal pain. *Cochrane Database of Systematic Review, 3*, CD005660.

Max, M. B., Donovan, M., Miaskowski, C. A., Ward, S. E., Gordon, D., Bookbinder, M., Cleeland, C. S., Coyle, N., Kiss, M., Thaler, H. T., & Janjan, N. (1995). Quality improvement guidelines for the treatment of acute pain and cancer pain. *JAMA, 274*(23), 1874–1880.

Minick, P., Clark, P. C., Dalton, J. A., Horne, E., Greene, D., & Brown, M. (2012). Long-bone fracture pain management in the emergency department. *Journal of Emergency Nursing, 38*(3), 211–217.

Muntlin, Å., Carlsson, M., Säfwenberg, U., & Gunningberg, L. (2011). Outcomes of a nurse-initiated intravenous analgesic protocol for abdominal pain in an emergency department: a quasi-experimental study. *International Journal of Nursing Studies, 48*(1), 13–23.

Newton-Brown, E., Fitzgerald, L., & Mitra, B. (2014). Audit improves emergency department triage, assessment, multi-modal analgesia and nerve block use in the management of pain in older people with neck of femur fracture. *Australasian Emergency Nursing Journal, 17*(4), 176–183.

Patrick, P. A., Rosenthal, B. M., Iezzi, C. A., & Brand, D. A. (2015). Timely pain management in the emergency department. *Journal of Emergency Medicine, 48*(3), 267–273.

Phillips, S., Gift, M., Gelot, S., Duong, M., & Tapp, H. (2013). Assessing the relationship between the level of pain control and patient satisfaction. *Journal of Pain Research, 6*, 683.

Pierik, J. (2016). *Pain following extremity injury: management, predictions and outcomes (doctor's thesis)*. Enschede: University of Twente. https://doi.org/10.3990/1.9789036542166.

Pierik, J. G., Berben, S. A., IJzerman, M. J., Gaakeer, M. I., van Eenennaam, F. L., van Vugt, A. B., & Doggen, C. J. (2016). A nurse-initiated pain protocol in the ED improves pain treatment in patients with acute musculoskeletal pain. *International Emergency Nursing, 27*, 3–10.

Polit, D. F., & Beck, C. T. (2004). *Nursing research: principles and methods*. Philadelphia, PA: Lippincott Williams & Wilkins.

Popil, I. (2011). Promotion of critical thinking by using case studies as teaching method. *Nurse Education Today, 31*(2), 204–207.

Rahmati, H., Azmoon, M., Meibodi, M. K., & Zare, N. (2013). Effects of triage education on knowledge, practice and qualitative index of emergency room staff: a quasi-interventional study. *Bulletin of Emergency & Trauma, 1*(2), 69.

Ridderikhof, M. L., Schyns, F. J., Schep, N. W., Lirk, P., Hollmann, M. W., & Goslings, J. C. (2017). Emergency department pain management in adult patients with traumatic injuries before and after implementation of a nurse-initiated pain treatment protocol utilizing fentanyl for severe pain. *Journal of Emergency Medicine, 52*(4), 417–425.

Scholten, A. C., Berben, S. A. A., Westmaas, A. H., van Grunsven, P. M., de Vaal, E. T., Rood, P. M., Hoogerwerf, N., Doggen, C. J., & Schoonhoven, L. (2015). Pain management in trauma patients in (pre) hospital based emergency care: current practice versus new guideline. *Injury, 46*(5), 798–806.

Sokoloff, C., Daoust, R., Paquet, J., & Chauny, J.-M. (2014). Is adequate pain relief and time to analgesia associated with emergency department length of stay? A retrospective study. *BMJ Open, 4*(3), e004288.

Vatnøy, T. K., Fossum, M., Smith, N., & Slettebø, Å. (2013). Triage assessment of registered nurses in the emergency department. *International Emergency Nursing, 21*(2), 89–96.

Wong, E. M. L., Chan, H. M. S., & Rainer, T. H. (2007). The effect of a triage pain management protocol for minor musculoskeletal injury patients in a Hong Kong emergency department. *Australasian Emergency Nursing Journal, 10*(2), 64–72.