

Research Article

Development of a Workplace-Based Training Program for Nurse-Led Ultrasound-Guided Femoral Nerve Blocks: A Feasibility Study with the Patients' Perspective in Focus

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Background. Task shifting is a systematic delegation of tasks in order to make more efficient use of the available human resources for health. Training programs and the quality of these are sparsely studied and specially they that include the patients' perspectives to an even lesser degree. **Aim.** A single-center feasibility study with a convergent parallel mixed method approach, integrating quantitative and qualitative components, was conducted at an emergency department aimed to evaluate a training program for nurse-led ultrasound-guided femoral nerve block. **Method.** Registered nurses (RNs) ($n = 5$), supervising anesthesiologists ($n = 7$), and patients with hip fracture ($n = 15$) participated. The training consisted of a one-day program that included comprehensive theoretical and practical instruction in anatomy, hygiene, and the application of ultrasound. The one-day training program was evaluated through an objective structured clinical examination (OSCE). Following that, each registered nurse conducted three supervised procedures in the weeks that followed. These procedures were performed on patients admitted with hip fractures in the emergency department. The patients ($n = 15$) were interviewed regarding their experiences and perspectives of pain, safety, and information of the procedures in emergency department. **Results.** In questionnaire, the RNs and anesthesiologists agreed that the training procedures were beneficial for the patients due to pain relief. Pain intensity showed a mean baseline pain score of 6.0 (95% CI 4.9–7.1) decreasing to 2.5 (95% CI 1.4–3.6) at 30 minutes after needle extraction. The interviews revealed that all patients experienced pain relief after the in situ nerve block training procedures as well as they felt safe and taken care of. **Conclusions.** The training program for nurse-led ultrasound-guided femoral nerve blocks was considered feasible. All included RNs learned the procedure for task shifting in a satisfactory way.

1. Introduction

Education and training are needed to ensure that task shifting is optimized to the benefit of health care personnel and their patients [1–3]. A recent report from the European Union [4] identifies a knowledge gap regarding the development of training programs for task shifting, as this has

rarely been evaluated and there is limited evidence. To address this, we need more studies examining how to conduct training programs that are safe, effective, and can be carried out with limited resources in a hectic environment. In this paper, we describe the first step in a larger study on task shifting at an emergency department. The present study is an evaluation of the feasibility of an in situ training

program for nurse-led ultrasound-guided femoral nerve blocks in a single center in Norway.

A practice of person-centered care is recommended within the modern health care system. Person-centered care strives to find approaches that increase people's well-being and can fit to different ages, conditions, and settings. The core feature of person-centered care consists of acknowledging the patient as a person who actively participates in his/her health and is a codesigner in implementation and educational programs [5]. Therefore, it is of great importance to understand patients' experiences of the process and whether these outcomes translate into improved quality of care [6, 7].

The World Health Organization (WHO) reports that life expectancy has increased [8], and in the future, the percentage of elderly people with high care demands in the population will rise as fertility of the younger generations declines [9]. A global shortage of 18 million health workers is expected by 2030 [10], and it is therefore important to prepare the health care workforce for future challenges.

Task shifting in health service delivery is a transfer of specific tasks from health personnel with higher levels of training to those with less training [4]. Accordingly, WHO endorses a task shifting approach to optimize use of the available human resources for health care. Recently, several examples of task shifting from physicians to nurses have been described, especially in primary care, but also in emergency departments [11–13], which suggest that properly trained registered nurses can provide as high quality primary care as physicians with favorable patient safety outcomes [14].

Globally, over one million hip fractures occur annually, a trauma that is closely related to acute distinct pain in the proximal part of the affected extremity [15]. Experiencing severe pain is associated with increased length of hospital stay, higher risk of delirium, movement restriction, mobilization difficulties, and reduced health-related quality of life [16]. Therefore, waiting for adequate pain relief poses a risk of these consequences [17].

An ultrasound-guided femoral nerve block is a valuable alternative to systemic analgesic in hip fracture patients as it provides analgesia to the fractured area, thereby facilitating reduction in systemic opioid administration [18]. Providing optimal pain control in hip fracture patients requires advanced nursing and physician care due to comorbidity [19–21]. Thus, optimizing acute pain assessment and management is important. As registered nurses in emergency departments are usually the first to attend hip fracture patients, task shifting may be necessary to provide ultrasound-guided femoral nerve blocks early. To our knowledge, this is the first study investigating a multidisciplinary, in situ training program for nurse-led ultrasound-guided femoral nerve blocks using a combined qualitative and quantitative approach for evaluation of the training program.

Accordingly, the research problem is to evaluate the feasibility of an in situ training program for nurse-led ultrasound-guided femoral nerve block. The study aims to identify the effectiveness of the training program from three different perspectives: (1) an objective structured clinical

examination (OSCE), (2) three in situ practical procedures under supervision, and (3) patients' experiences of pain intensity and how they experienced taking part of the training program.

The present study holds a triple significance composing of (1) the revelation of novel techniques and frameworks for imparting training on new tasks within the health care sector, (2) the incorporation of patient input that offers valuable insight into their participation experiences during the training program, and (3) demonstration of the feasibility of conducting a training program within the confines of the workplace.

2. Materials and Methods

2.1. Design. This study is a single-center feasibility study with a convergent parallel mixed method approach [22] that combines quantitative and qualitative components to evaluate the training program. The data were collected simultaneously and analyzed separately for the purpose of breadth and depth of understanding and corroboration. The study was conducted in an emergency department in a hospital in Norway.

Feasibility studies are designed to answer the overarching question "Can it work?" examining the acceptability of the intervention and study procedures and are typically performed prior to a randomized control trial [23]. This study was first performed in a simulation center and later in situ. A recent review has shown that in situ simulation is useful for skill improvement and as a method of continuing education [24] as it is a team-based training procedure conducted in real-life patient care using authentic medical equipment and human resources.

The training comprised a one-day-training program and an OSCE, followed by three supervised procedures per registered nurse performed during the following weeks as patients were admitted with hip fractures in the emergency department. The process that was followed is demonstrated in Figure 1.

2.2. Participants. Five of the 19 registered nurses who applied to take part in the project were invited to participate. They were all employees in the emergency department at a hospital in Norway covering a population of 240,000 individuals. The nurses were purposely selected according to the following criteria: possession of senior staff experience, motivation to learn the advanced procedure, certification in advanced cardiopulmonary resuscitation, and an employment contract for at least a 75% position. Team of five registered nurses was found sufficient to establish a continuous presence of registered nurses with this type of training in the emergency department. Fourteen registered nurses were excluded due to less experience, other ongoing continuing education, and employment less than 75% position.

The chief anesthesiologist recruited anesthesiologists on a voluntary basis, and all consented to participate. Anesthesiologists and registered nurses all signed an informed

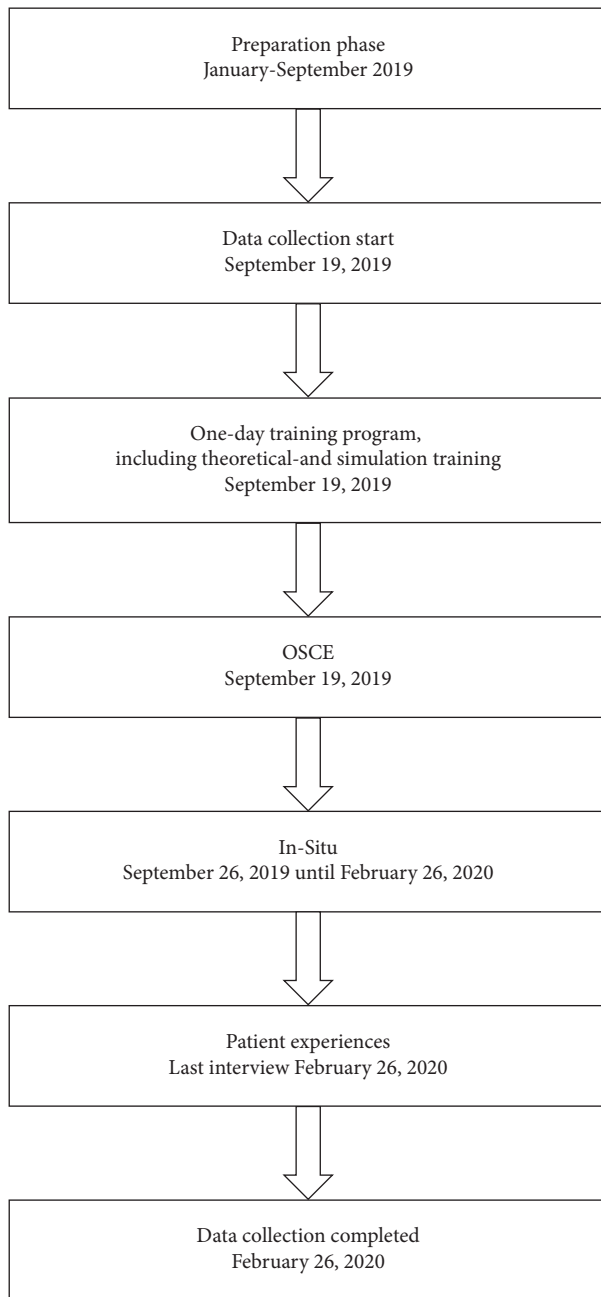


FIGURE 1: Illustration of the timeline in the training program and data collection for nurse-led ultrasound-guided femoral nerve blocks. OSCE: objective structured clinical examination; in-situ: simulation was performed in situ in the actual setting where the nurses work.

written consent. Patients were included during day, evening, and night shifts.

After the initial one-day training, 15 consecutive patients as in convenience sampling were included in accordance with the following inclusion criteria: patients needed to be ≥ 18 years and diagnosed with a radiologically confirmed hip fracture. All patients had to have an American Society of Anesthesiologists (ASA) [25] class 1–4. The ASA physical status classification system is a simple categorization of

a patient's physiological status to help predict the operative risk (Table 1).

The exclusion criteria were pregnancy; patients diagnosed with dementia or other cognitive challenges; patients without ability to give informed consent; and patients with known allergies to local anesthetics and concomitant use of anticoagulants or platelet inhibitors. However, if a recent (last 2 hours) international normalized ratio was below 1.5, warfarin was allowed. Uses of acetylsalicylic acid and dipyridamole were allowed.

2.3. The One-Day Training Program. The one-day training program (supplementary material 1) began with an instructional video. The video contained a review of how to perform sterile procedures and an explanation of how to adjust the ultrasound machine and use the ultrasound probe. Additionally, it described how to identify the relevant anatomical structures and in-plane needle technique.

In the second step of the training program, the nurses had to familiarize themselves with the local guidelines for ultrasound-guided femoral nerve blocks. The nurses went through theoretical and practical training divided into infection prevention, anatomy of the inguinal area, practical use of ultrasound, and measures to be taken in the event of complications. A living model (47-year-old female) was available to all nurses to explore the femoral nerve and the neighboring anatomical structures and landmarks with an ultrasound machine (VENUE, GE Healthcare, 9900 Innovation Drive Wauwatosa, WI 53226, USA) with a high frequency linear probe (10–15 MHz) under the supervision of an anesthesiologist. Additionally, we provided an ultrasound training phantom model (Gen II Femoral Vascular Access and Regional Anesthesia Ultrasound Training Model, Blue Phantom, CAE Healthcare, Edge Lake Drive, Sarasota, USA) for anatomy review but also to practice the injection technique using a single-shot nerve block needle (Pajunk® single-shot cannula, GM medical HS, Karl-Hall-Strasse 1, 78187 Geislingen, Germany).

All the instructors of this program were certified professionals in their respective fields. Researcher one was a senior physician in anesthesiology with a doctoral degree. Researcher two was a registered nurse possessing a PhD and a degree in pedagogy, certified for teaching nursing education and OSCE. Finally, researcher three was a registered nurse with significant clinical expertise in certifying health professionals in emergency medicine.

2.4. Objective Structured Clinical Examination (OSCE). At the end of the one-day training program, the nurses had to complete a practical exam similar to the OSCE (supplementary material 2) with an assessment committee consisting of the researchers and two anesthesiologists. The committee censored with an aim to ensure that the nurses could perform the ultrasound-guided femoral nerve block procedure correctly. To pass the OSCE and advance in the program to perform supervised blocks in real patients, there had to be a consensus among members of the assessment committee. The nurses' knowledge and practical skills were

TABLE 1: Baseline characteristics of patients involved in the in situ training ($n = 15$).

Demographic characteristics	N	%	Mean	SD	Range
Age (years)	15		83.1	8.4	67–94
Gender					
Female	12	80			
Male	3	20			
BMI (kg/m ²)	15		25.5	2.8	22.03–31.22
ASA classification ^a					
1	0	0			
2	11	73			
3	3	20			
4	1	7			

ASA classification: American Society of Anaesthesiologists; BMI: body mass index; SD: standard deviation; ASA 1: a normal healthy patient; ASA 2: a patient with mild systemic disease; ASA 3: a patient with severe systemic disease; ASA 4: a patient with severe systemic disease that is a constant threat to life.

evaluated based on the following criteria: (1) correct performance of sterile procedure, (2) correct management of the ultrasound machine and satisfactory oral description of the inguinal anatomic structures, (3) correct preparation of the local anesthetic drug and satisfactory performance of the nerve block on the phantom, and (4) ability to explain how they would handle cardiopulmonary resuscitation and manage complications and toxic reactions. To pass the OSCE, the nurses had to earn at least seven points out of a maximum of eight.

2.5. Three In Situ Supervised Ultrasound-Guided Femoral Nerve Blocks. Finally, each nurse performed a minimum of three procedures in situ under the supervision of an anesthesiologist during the next weeks. Patients were included only when an anesthesiologist was able to attend the emergency department to supervise. All patients received intravenous access and were monitored with noninvasive blood pressure, electrocardiogram, and peripheral oxygen saturation until 30 minutes postprocedure to observe any adverse events. Heart rate and respiration rate were recorded. During the in situ nerve block, the nurse was given feedback from the anesthesiologist regarding the identification of the anatomic structures observed in the ultrasound image and the needle technique, if needed.

The nurses performed the nerve blocks using the same ultrasound machine, probe, and needle as used during the one-day training program. Once the nerve was located, the needle tip was guided by ultrasound close to the nerve. An injection containing 20 ml ropivacaine 7.5 mg/ml (Ropivacaine, Fresenius Kabi, P.O. Box 4646, Nydalen 0405 Oslo, Norway) was administered to encircle the nerve.

2.6. Dynamic Pain. Immediately after the needle was withdrawn and every 30 minutes until 120 minutes after the procedure, the patients were asked for numeric rating scale (NRS) pain scores at rest and dynamic [26, 27]. Dynamic pain intensity was captured by an NRS score recorded during flexion of the fractured hip between zero and 30 degrees. Dynamic pain is an important outcome for pain relief in order to prevent immobilization and ensure the implementation of necessary preoperative procedures [28].

The choice to include three supervised procedures was based on studies describing fascia iliaca nerve blocks or femoral nerve blocks using ultrasound. These studies had from one to five supervised blocks on either volunteers, cadavers, or patients [29–32].

Within 24 hours after the injection, all patients were visited at the ward to assess the injection site, which was inspected for possible development of infection, pseudoaneurysm, or hematoma. Patients were asked if they had any sustained pain or numbness in the skin innervated by the femoral nerve. Sustained reduced sensation of the area innervated by the femoral nerve was flagged to be followed up for any sign of a nerve injury.

Since assessing pain is an essential step towards managing it, we needed to have a valid and reliable pain assessment method. The perception of pain is highly subjective and can be challenging to assess. The NRS requires the patient to be able to rate their pain on a scale from 0 (no pain) to 10 (strongest pain imaginable), and it takes less than one minute to complete. The nurses were trained in a motion pain test and had illustrations to help determine the approximate range of motion between zero and 30 degrees. The 30-degree maximum for the passive movement of the hip was endorsed by the chief of orthopedic surgery, in line with the standard of care and inspired by previous studies [33, 34]. We interrupted the motion pain test if the patient expressed intense pain.

The patients were asked to score their pain intensity at inclusion, called the baseline, and then at the time of the needle extraction of the supervised ultrasound-guided femoral nerve block, called time point 0, and further at 30, 60, 90, and 120 minutes after needle extraction. The nurses performed these measurements, and quality was assured by another colleague at work at the time. The maximum achieved number of degrees for each patient was noted in the case report form.

2.7. Questionnaires. To assess the quality of the procedure we developed an original five-item questionnaire to both the nurse (supplementary material 3a.) and the anesthesiologist (supplementary material 3b) after each procedure. The questionnaire included the following topics: (1) complexity

of the procedure, (2) immediate experience of successfulness of the procedure, (3) ease of identification of anatomical structures in the ultrasound image, (4) evaluation of the spread of the local anesthetic, and (5) opinion about whether the patient experienced a benefit from the nerve block. Both the nurses and the anesthesiologist responded on a four- or five-point Likert scale immediately after each nerve block procedure was completed. The questionnaire was pilot tested for face validity on both registered nurses and anesthesiologists prior to data collection and adjusted based on their feedback.

The quantitative NRS data and questionnaires provided data regarding measure of pain and quality of the procedures. However, in order to investigate how the patients experienced objective pain and procedures, semistructured interviews were suitable for gaining deeper knowledge in addition to the quantitative data [35].

2.8. Interviews. Finally, we conducted semistructured individual interviews (supplementary material 4) with the included patients to learn more about their experiences of the procedures in the emergency department regarding (1) pain and the effects of the procedure, (2) perspectives on the safety of the procedure, (3) information given, and (4) perspectives on the competence of the registered nurses. Individual interviews were conducted in the hospital ward approximately 24 hours after the procedure, depending on the patient's condition or scheduled operating time, to ensure that the patients were able to remember the in situ training nerve block. The same researcher performed all interviews alone and bedside in the ward to ensure confidentiality. The interviews lasted between 30 and 40 minutes and were documented in written notes.

2.9. Ethical Considerations. The Regional Committees for Medical Research Ethics–South East Norway approved the study to be health service research (2019/343 REK–South-east). The Norwegian Center for Research Data (ID 533039/2019) and data protection officer at the investigational site approved the study (ID06011/2019). The study was retrospectively registered in <https://www.clinicaltrials.gov/> (Date: 08.12-20, NCT04659395).

Written informed consent was obtained from the patients, registered nurses, and anesthesiologists. All interviews were written down and downloaded onto a secure server.

The study lasted for six months starting in 2019 and ended in 2020.

2.10. Quantitative Analysis. All quantitative data, including patient background data, pain ratings and questionnaires, were plotted into EpiData (The EpiData Association, Engshavevej 34, Odense, Denmark, program version 4.6.0.2 r720) and transferred to Stata for statistical analysis.

Descriptive statistics were presented as frequencies and proportions for categorical data and as the mean, standard deviation (SD), and range for continuous data. The level of

agreement was calculated as the proportion of patients for whom the anesthesiologists and nurses gave identical responses. Cohen's kappa with quadratic weighting was used to measure the agreement between the nurses' and anesthesiologists' responses. Kappa was interpreted as 0–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1.0 almost perfect [36]. To evaluate internal consistency of the questionnaire, we used Cronbach's alpha [37]. Quantitative analyses were performed by the researchers ES and RSF (statistician).

2.11. Qualitative Analysis. The interviews were analyzed using manifest content analysis as described by Graneheim and Lundman [38]. Two of the researchers (ES and KS) read the texts independently with the aim of describing what the participants said. We stayed close to the text, used the patient's own words, and described what was visible and obvious in the text. The texts were summarized and condensed into three categories that described differences and similarities based on the participants' experiences: (1) experience of pain, (2) experience of being safe, and (3) experiences of communication difficulties.

3. Results

3.1. Baseline Characteristics. A total of 27 participants, five registered nurses, seven anesthesiologists, and 15 patients (12 women and three men) agreed to participate in the study. No patient refused to participate. All five nurses passed the OSCE with eight out of eight points and accordingly qualified to move on to the in situ supervised femoral nerve blocks. The five nurses each performed three in situ supervised femoral nerve blocks on a total of 15 study patients. Demographic data are presented in Table 1. No adverse events due to the ultrasound-guided femoral nerve blocks were observed in any of the patients.

3.2. Pain Intensity. At the baseline, the patients' mean dynamic pain intensity score was 6.0 (95% CI 4.9–7.1) on the NRS, illustrated in Figure 2. The pain intensity decreased to 3.8 (95% CI 2.7–4.9) at 0 min (defined as needle extraction) and to 2.5 (1.4–3.6) at 30 min after needle extraction. Thereafter, the pain intensity plateaued at about 3. All patients had pain scores recorded for all six time points.

3.3. Questionnaires. The registered nurses and the anesthesiologists were in substantial agreement (kappa 0.75) regarding the complexity of the ultrasound-guided femoral nerve block procedures (Table 2). There was moderate agreement (kappa 0.66) between the nurses and the anesthesiologists about the immediate experience of the successfulness of the procedures. Recognition of anatomic structures was considered the most challenging part of the procedure to agree upon, yielding a kappa of 0.18. In case of disagreement (67%), the anesthesiologists systematically considered that the nurses identified anatomical structures on ultrasound better than the nurses' self-assessment. There

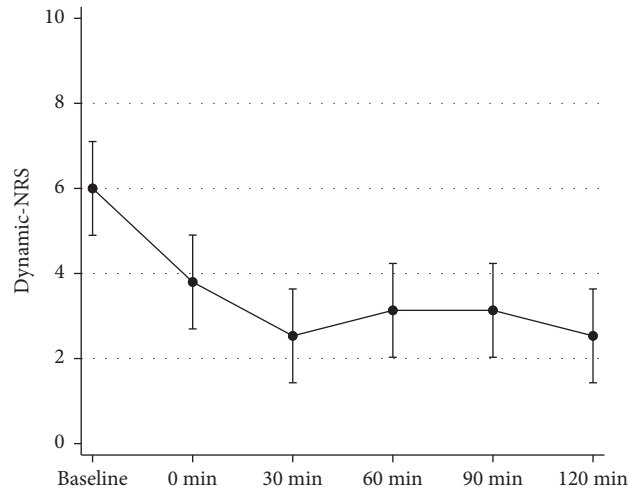


FIGURE 2: Dynamic numeric rating scale (NRS) with 95% confidence interval from inclusion to 120 min after needle extraction in ultrasound-guided femoral nerve block patients ($n = 15$). Baseline: defined as patients included in the in situ training. Dynamic-NRS: numeric rating scale score recorded during flexion of the fractured hip. Maximum elevation of the hip was 30 degrees. NRS: numeric rating scale; min: minutes.

TABLE 2: Results from the questionnaire responses from the anesthesiologists and registered nurses immediately after the in situ training procedures.

No	Item	Level of agreement (%)	Cohens kappa
1	The complexity of the procedure	73	0.75
2	Immediate experience of successfulness of the procedure	67	0.66
3	Identify recognizable anatomical structures in the ultrasound image	33	0.18
4	The spread of the local anesthetic	60	0.59
5	Patient benefited from this nerve block due to pain relief	67	0.62

was moderate agreement on the spread of anesthesia (kappa 0.59), and there was substantial agreement that the procedure was beneficial for the patients due to pain relief (kappa 0.62). Cronbach's alpha of the overall scale was 0.7 (acceptable).

3.4. Patient Experiences of Pain and Task Shifting

3.4.1. Experiences of Pain. All the patients experienced severe pain before the ultrasound-guided femoral nerve block. Their narratives revealed that they experienced severe pain during movement, which they described as cruel, extreme, horrible, prickly, sharp, or insane.

One patient elaborated, "I did not have pain when I was still and calm, but as soon as I moved there was a lot of pain, sharp, sharp pain. It was cruel".

Generally, the pain was described as worse during movement, and some patients reported not being able to move the limb at all. After the supervised nerve blocks in situ, the patients all described pain relief. The nurses had told the patients that it might take some time before they felt less pain, and this was in line with what patients reported. Nevertheless, most patients experienced pain relief

immediately after the procedure. They described pain relief and the feeling that the leg was no longer their own. It was numb.

One patient said, "My hip no longer hurt. It was numb, but not as painful as before; my leg felt strange, almost like it was not my leg".

The interviews indicated that the patients also remembered the methods used for testing pain intensity and reported that the nurses were able to elevate the fractured leg higher after the ultrasound-guided femoral nerve block.

3.4.2. Experiences of Being Safe. The participants repeatedly expressed that they felt they were "being taken care of," "being taken seriously," "being comforted," and "not feeling scared or anxious." Being taken seriously by health care personnel, regardless of their role, seemed to be especially important to participants when it came to feeling safe.

One patient remarked, "They took me seriously, I felt it".

The patients also experienced that the nurses continuously informed them about what they were going to do and what to expect during and after the procedure. Furthermore,

none of the patients expressed concerns about whether it was a registered nurse or a physician performing the ultrasound-guided femoral nerve block. The most important thing was that the procedure resulted in pain relief.

One patient said, *“The nurse who gave me the analgesic was always very good at explaining; it did not matter that it was a nurse, I did not think about it either. I felt safe, and taken care of, the nurse was in control, nothing to say, a brilliant job”*.

3.4.3. Experiences of Communication Difficulties. The patients described receiving information from the nurses including who was going to carry out the procedure and about the training program; this made them feel safe. At the same time, the patients stated that they did not remember much of the information. Most of them had impaired hearing or needed hearing aids.

One patient commented, *“I have hearing loss, but I think I received good information all along, especially from those who put “that sting” in my leg”*.

Another patient announced; *“I should have brought my hearing aid with me to the hospital!”*

Together with the hearing impairment, the patients said that there were many people involved in the care and that this made them confused.

One of the participants expressed it like this; *“Two ladies came and they said something about all the practicalities, then suddenly they were many, it became too much for me. I did not follow what they said, oh dear vain, it was four, five, six persons involved”*.

4. Discussion

In this study, we aimed to evaluate the feasibility of a training program for nurse-led ultrasound-guided femoral nerve block, from both quantitative and qualitative perspectives.

All registered nurses passed the OSCE after the one-day training program and thus went on to perform three supervised nerve blocks on patients in the emergency department. Our mixed method approach has made it possible to evaluate the feasibility of this training program from three perspectives: (1) training and assessment, (2) in situ training, and (3) the patients' experiences.

4.1. Training and Assessment. Building clinical skills requires a training program that is built on both theoretical knowledge and practical performance [39] and must be seen in interaction among practices, context, and individuals [40]. As a preparation for the three supervised femoral nerve blocks, we found that it was important to assess the knowledge and skills acquired during the one-day training program through an objective structured clinical evaluation (OSCE) developed to evaluate the most crucial parts of the

one-day training program and establish a minimum level of competence. All nurses in the training program passed the OSCE and were thus eligible for the in situ training. An OSCE has the advantage of being both a formal evaluation of competence and a methodology to provide immediate feedback and has been found to improve the quality of the learning for those in training [41, 42].

4.2. In Situ Training. During supervision of the three in situ femoral nerve blocks, the registered nurses received immediate feedback. Moreover, they were able to discuss any challenges they encountered regarding identification of the anatomic structure, the complexity of the nerve block, or the successfulness of the procedure with the supervising anesthesiologist during and after the procedure. Aebersold Tschannen [43] identifies simulation as a suitable methodology in nursing education and highlights that it does not have to be costly or be high-fidelity [43]. Our simulation was performed in situ, in the actual setting where the nurses work, which is cost effective and gives the nurses the opportunity to perform supervised procedures in a known setting with the authentic equipment available onsite. In this study, we designed a training program that progressed from theory to simulation and finally to in situ training on real patients.

Further, we aimed at building a close nurse-physician relationship by letting the registered nurses and anesthesiologists work together through the entire learning process. A study by Karimi-Shahanjarini et al. [44] involved physicians, nurses, and patients in their study and pinpointed some important perspectives in order to successfully implement task shifting. Nurses cited satisfactory training, close nurse-physician relationships, and respect from physicians as important factors, whereas physicians and nurses both pinpointed the need for sufficient resources and time to train for task shifting [44]. In our case, the time and resources available for such training might not have been optimal since the supervised part of the training program was carried out using existing resources during working hours in a hectic environment without extra time set aside for either the nurses or the supervising anesthesiologists. Nevertheless, these conditions reflect the reality of an emergency department and the context in which competence development must take place [45].

4.3. Experiences of the Success of the Procedures. To evaluate how anesthesiologists and registered nurses assessed the in situ supervised femoral nerve blocks, we conducted a short survey. Our results indicate that both groups considered the nerve block successful and that the patients benefited from it due to a reduction in pain. However, there was less agreement regarding recognition of anatomic structures during ultrasound and the spread of anesthesia. This inconsistency might have been due to differences in the academic level between the nurses and the anesthesiologists, differences in experience with using ultrasound, and the complexity of the targeted structure. Ultrasound identification of the nerve seems to be challenging for nurses who

have no previous experience in identifying anatomic structures by ultrasound. However, Vardell et al. [46] found that emergency nurses with no prior ultrasound experience could obtain images to improve procedural success and safety, as well as detect and differentiate between a variety of traumatic and soft tissue injuries with a moderate level of accuracy [46]. Stolz et al. [47] describe the outcomes and curriculum components of an educational program to train nonphysician clinicians working in emergency departments in the use of point of care ultrasound [47]. The findings suggest that if properly educated, these clinicians will adopt ultrasound in their clinical practice rapidly and will utilize it frequently [47].

4.4. Patient Perspectives on Nurse-Led Femoral Nerve Block Training. Analysis of the interviews revealed that all patients experienced pain relief after the in situ nerve block. The patients notably reported experiencing severe pain in motion which subsided when the nurse lifted their legs after the procedure. This is in line with the quantitative results, where pain intensity in motion measured by NRS from time of inclusion until 120 minutes after the needle extraction indicated that the patients experienced a pain reduction of more than 50%. Farrar et al. [48] define a 30% decrease in the NRS score (approximately 2 points) as clinically significant [48]. The NRS has good sensitivity, provides scores that can be statistically analyzed, is validated, and is used in many emergency departments [49]. However, there is a potential for error when using the NRS if the context and the subjective experience of pain are not taken into account [50]. In addition, the small sample size of only 15 patients does not permit generalization about pain reduction from a purely quantitative perspective. Therefore, we found it essential to explore other perspectives that might be of significance, notably that of the patient.

The patients in the present study highlighted that the nurses made them feel safe and taken care of. According to Shankar et al., patients' perceptions of quality in emergency department settings are shaped by their experience of care, including feeling welcomed, reasonable waiting times, receiving adequate information, and increased communication with staff [51]. This might be why patients in our study reported that it did not matter who performed the nerve block: patient-staff communication, empathy, compassion, and waiting times were more important. In contrast, these results differ from research on primary care, where studies have investigated patient's perspectives on nurses taking over medical tasks. Karimi-Shahanjarini et al. [44] found that patients preferred physicians when the task was of a medical character but accepted nurses for tasks related to follow-up and preventive care.

Very few studies have taken patients' perspectives into account in training for new tasks [4]. The qualitative inquiry in this study is an approach to better understand how meaning is constructed and gain a more comprehensive understanding of how patients experienced the in situ training procedures and whether the procedure and interaction with the nurses was translated into quality of care. The patient's own words shed a light on these perspectives of

our training. The mixed method approach can be considered a strength of this study as it allows us to combine qualitative and quantitative data that corroborate different perspectives through numbers and charts and the patient's perspectives through qualitative lenses [52].

4.5. Limitations. Limitations of this study pertain to the interviews of the patients and the original questionnaire. There are several reasons for the methodological choice of performing short interviews without an audio recorder. Short interviews were considered less burdensome for the patients. We found that the qualitative data were sufficient although limited, as they provided important perspectives that have never been investigated in similar studies. We chose not to use an audio recorder due to patient privacy and ethical issues and instead take notes during the interview. This could, however, have allowed for initial biases from the researchers' own interpretation and misunderstandings of the patient's statements. There is also a risk that the researcher was selective in terms of what patient answers were written down. Nevertheless, we found the quality of the text from the interviews, and the quotes and experiences from the patient's point of view, to be sufficient for further analysis.

The questionnaire used to assess the quality of the supervised nerve blocks was pilot tested for face validity on the users but was not tested for content or construct validity. This might be considered a limitation of this study. The main reason for not using a validated questionnaire to measure the level of agreement between registered nurses and anesthesiologists is the absence of such a tool. Further research on this questionnaire, or development of a new tool for assessing the quality of procedures for task shifting, is therefore necessary.

5. Implications for Practice and Further Research

In line with feasibility studies, the results are not expected to be generalizable. However, the findings in our study indicate that we can expect that the results would be similar if our training program was implemented in a similar context in other countries with a similar health care system. Also, patient involvement should be taken into account when planning and implementing training programs for task shifting. We find that the training program for nurse-led ultrasound-guided femoral nerve block is feasible, and all included registered nurses learned the procedure for task shifting and were thus eligible for further research on the effectiveness of task shifting in a randomized control trial.

Experiences from this current study might also lead to further research into how task shifting can affect the established roles, responsibility changes and workload for health care personnel.

Furthermore, this current study might be used as framework for developing a training program for task shifting within other types of nerve blocks such as ultrasound-guided sciatic-femoral and ankle blocks [53].

6. Conclusion

The training program for nurse-led ultrasound-guided femoral nerve block was assessed in an OSCE, followed by three in situ practical procedures under supervision, and finally, patients' experiences of pain intensity and how they experienced taking part of the training program were investigated. The training program presented in this article was workplace based and relatively short and was conducted in a hectic environment in an emergency department without any extra resources. The registered nurses and anesthesiologists were in moderate agreement regarding the successfulness of the procedure and its benefit to patients in terms of pain relief. Patient interviews revealed that all patients experienced pain relief after the in situ nerve block and that the patients felt safe and taken care of during the training.

In summary, based on our results, the proposed training program for ultrasound-guided femoral nerve block seems feasible for shifting this task from anesthesiologists to registered nurses.

Abbreviations

ASA: American Society of Anesthesiologists
 NRS: Numeric rating scale
 OSCE: Objective structured clinical examination
 WHO: World Health Organization.

Data Availability

The data that support the findings of this study are available on reasonable request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

E.S. prepared the study, collected, analyzed, planned, and carried out the one-day training course in femoral nerve blocks and interpreted the data related to training registered nurses in performing ultrasound-guided femoral nerve blocks and wrote the manuscript. K.S. was a major contributor to guiding the qualitative data analysis and contributed to the writing process. E.L. planned and carried out the one-day training course in femoral nerve blocks and was the main author of study protocol and contributed to the writing process. R.S.F. was a major contributor to guiding the quantitative analysis, commented on the final manuscript, and contributed to the writing process. P.C.B-J. contributed to conceptualization, investigation, and methodology design and was a major contributor to writing the manuscript. All authors read and approved the final manuscript.

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Supplementary Materials

Supplementary material 1: program for training nurses: ultrasound-guided femoral nerve block, one-day training course. Supplementary material 2: training emergency department nurses to perform an ultrasound-guided femoral nerve block in hip fracture patients; the objective structured clinical examination (OSCE) form. Supplementary material 3: questionnaire, given to both the registered nurse and anesthesiologist after each procedure. Supplementary material 4: interview guide for individual patient interview. (*Supplementary Materials*)

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