Pediatric postoperative pain management in postanesthesia care units in Norway

- cluster randomized trial using different methodological approaches

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Sammendrag

Mange barn opplever smerte etter operasjon, og postoperativ smerte hos barn er undervurdert og underbehandlet. Ubehandlet smerte kan føre til unødvendig lidelse, komplikasjoner, lengre sykehusopphold, og for noen langvarig smerte. Årsaker til underbehandlet smerte kan være helsepersonells manglende kunnskap og kompetanse innen postoperativ smertebehandling. Sykepleiere som jobber på postoperative overvåkningsavdelinger (PO) har en essensiell rolle i smertebehandling. Tidligere forskning viser at sykepleiere som jobber på barneavdelinger mangler kunnskap om smertebehandling. Det var behov for mer kunnskap om postoperativ smertebehandling av barn på PO.

Hovedhensikten med denne studien var å få en bredere forståelse av postoperativ smertebehandling av barn på PO i Norge, samt å undersøke gjennomførbarheten og effektene av skreddersydd utdanningsintervensjon.

Studien har en klynge randomisert design, ved bruk av triangulering med tre ulike metodiske tilnærminger (spørreundersøkelse for sykepleiere, observasjonsstudie av sykepleieres kliniske praksis og intervju av barn) ved tre måletidspunkt (baseline, en måned og seks måneder etter intervensjon).

Denne avhandlingen består av tre del-studier. I del-studie I, kartla vi sykepleiernes kunnskaper og kompetanse innen postoperativ smertebehandling av barn på PO. I del-studie II, undersøkte vi barns opplevelse av smerte og smertebehandling på PO. Basert på tidligere forskning og resultatene fra del-studie I og II, utviklet vi en intervensjon, og i del-studie III evaluerte vi om den skreddersydde utdanningsintervensjonen økte sykepleiernes kunnskaper om barn og smerte og bedret postoperativ smertebehandling av barn på PO.

Studien er gjennomført på PO-avdelinger ved seks universitetssykehus i Norge, og deltakerne er klynge-randomisert per avdeling til enten intervensjons- eller kontrollgruppe.

Intervensjonsgruppen fikk skreddersydd utdanningsintervensjon som var basert på tidligere forskning og resultater fra baseline, hvor vi brukte Det Konsoliderte Rammeverket For Implementeringsforskning som rammeverk og kunnskapstranlasjonsstategier. Intervensjonen inkluderte undervisningsdag, klinisk veiledning, og utlevering av smertevurderingsverktøy og ikke-medikamentelt utstyr. Etter intervensjonen var det påminnere for å styrke kunnskapstranlasjonen.

Hovedresultatene fra studien viser suboptimal smertebehandling og identifiserer mange barrierer for optimal smertebehandling. Ved baseline hadde sykepleierne manglende kunnskap og kompetanse innen smertebehandling av barn, og barn opplevde moderate til sterke smerter. Få barn var smertevurdert med smertevurderingsverktøy og barna fikk inadekvat smertelindring. Ikke-medikamentelle smertelindrelindrende tiltak var ofte brukt, og barna opplevde at det hjalp. Ved å kombinere ulike metoder, oppnådde vi bedre innsikt, hvor noen resultater var komplementære, noen sprikende og noen til og med motstridende. Barna ga verdifulle anbefalinger til hvordan en kunne forbedre smertebehandlingen.

Etter intervensjonen var det en positiv bedring innen postoperativ smertebehandling av barn. Sykepleiernes kunnskaper økte i intervensjonsgruppen, men etter å ha justert for baselineforskjeller, var det ingen statistisk signifikante forskjeller mellom gruppene. I intervensjonsgruppen, fant vi økt bruk at smertevurderingsverktøy, og barna rapporterte mindre moderat til sterke smerter. Begge gruppene økte bruk av ikke-medikamentelle smertelindrende tiltak og viste en positiv trend i medikamentell smertelindring.

Denne studien gir innsikt i sykepleiernes kunnskap og kompetanse innen postoperativ smertebehandling av barn ved PO-avdelinger i Norge, samt dypere forståelse om hvordan barn opplever smerte og smertebehandling.

Resultatene indikerer at det er behov for å bedre smertebehandlingen av barn på PO. Sykepleiernes kunnskapshull og manglende kompetanse i disse sentrale temaene innen smertebehandling av barn bør adresseres i sykepleierutdanningen (både grunnutdanningen og spesialsykepleierutdanningen) og ved å gjennomføre jevnlig klinisk trening i sykehusavdelingene. Det er behov for flere studier med større utvalg og tverrfaglig fokus, som inkluderer måling av langtidseffekt, for å utforske effekten av intervensjonsstudiers mulighet til å endre klinisk praksis.

Summary

Many children experience pain after surgery, and pediatric postoperative pain is often underestimated and undertreated. Unrelieved pain may increase unnecessary suffering, complications, hospital stay, and, for some patients, cause persistent postsurgical pain. The reasons for unrelieved pain may be that healthcare professionals lack knowledge and skills regarding postoperative pain management. Nurses working in the Postanesthesia Care Units (PACUs) play an essential role in pain management. Previous research shows that nurses working in pediatric wards lack knowledge of pain management. There was a need to explore pediatric postoperative pain management in PACUs.

The overall aim of this thesis was to gain a broader insight into pediatric postoperative pain management in PACUs in Norway, and to determine the feasibility and effects of a tailored educational intervention.

The present study has a cluster randomized design, using triangulation with three different methodological approaches (survey for nurses, observation study of nurses' clinical practice, and interviews with children) at three measurement points (baseline, one month, and six months after intervention).

This thesis consists of three substudies. In Substudy I, we explored pediatric postoperative pain management by measuring nurses' knowledge and attitudes and observing pediatric postoperative pain management clinical practice in PACUs. In Substudy II, we explored children's experiences of pain and postoperative pain management in PACUs. Based on the results from previous studies and from Substudies I and II, we developed a tailored educational intervention, and in Substudy III, we evaluated whether the tailored educational intervention increased nurses' knowledge and attitudes and improved pediatric postoperative pain management in PACUs.

The present study was conducted at PACUs in six university hospitals in Norway, and the participants were clustered and randomized by unit into an intervention or a control group. The intervention group received a tailored educational intervention based on previous research and the results from the baseline data using the Consolidated Framework for Implementing Research (CFIR) as a framework and knowledge translation (KT) strategies. The intervention consisted of an educational day, clinical supervision, and receiving pain

assessment tools and nonpharmacological equipment. After the intervention, there were reminders to enhance the KT.

The main findings of this study revealed suboptimal pain management and identified several barriers to optimal pain management. At baseline, nurses lack knowledge and skills in pediatric pain management, and children experience moderate to severe pain. Few children were assessed with pain assessment tools, and the children received inadequate pharmacological pain management. However, nonpharmacological pain-relieving techniques were often used, and children experienced it helpful. By combining the measurements, we received broader insight, where some results were complementary, but some were divergent and even contradictory. Furthermore, the children provided valuable recommendations on how to improve pain management.

After the intervention, there was a positive change in pediatric postoperative pain management. Nurses' knowledge improved in the intervention group, but when adjusted for baseline differences, there were no statistically significant overall differences in change between the groups. In the intervention group, there was increased use of pain assessment tools, and children reported less moderate to severe pain. Both groups increased their use of nonpharmacological pain-reliving techniques and showed a positive trend in pharmacological pain management.

This study provides insight into nurses' knowledge and pediatric postoperative pain management clinical practice in PACUs in Norway and a more in-depth understanding regarding the children's experience of pain and pain management.

These findings indicate that there is a need to improve pediatric pain management in PACUs. Nurses' lack of knowledge and skills concerning key topics in pediatric pain management should be addressed in the nursing curriculum (both for bachelor's and specialized nurses) and in ongoing in-service clinical educational training in hospital units. There is a need for more studies with larger samples, a multidisciplinary approach, and longitudinal studies to explore the effects of educational interventions to change clinical practice.

List of Original Papers

This thesis is based on the following papers, referred to as Substudies I-III.

I Smeland, A. H., Twycross, A., Lundeberg, S., & Rustøen, T. (2018). Nurses' knowledge, attitudes and clinical practice in pediatric postoperative pain management. *Pain Management Nursing: Official Journal of the American Society of Pain Management Nurses*, *19*(6), 585–598. https://doi.org/10.1016/j.pmn.2018.04.006

II Smeland, A. H., Rustøen, T., Naess, T., Nybro, L., Lundeberg, S., Reinertsen, H., Diseth, T. H., & Twycross, A. (2019). Children's views on postsurgical pain in recovery units in Norway: A qualitative study. *Journal of clinical nursing*, *28*(11–12), 2157–2170. https://doi.org/10.1111/jocn.14788

III Smeland, A. H., Twycross, A., Lundeberg, S., Småstuen, M. C., & Rustøen, T. (2022). Educational intervention to strengthen pediatric postoperative pain management: A cluster randomized trial. *Pain Management Nursing: Official Journal of the American Society of Pain Management Nurses*, *23*(4), 430–442. https://doi.org/10.1016/j.pmn.2021.09.007

Abbreviations

CFIR	Consolidated Framework for Implementing Research
CI	Confidence Interval
CONSORT	CONsolidated Standards of Reporting Trials
COREQ	Consolidated Criteria for Reporting Qualitative Studies
EBP	Evidence-Based Practice
FLACC	Face, Legs, Activity, Cry, Consolability Scale
FPS-R	Faces Pain Scale–Revised
GREET	Guidelines for Reporting Evidence-Based Practice Educational Intervention and Teaching
IASP	International Association for the Study of Pain
ITT	Intention-to-Treat
KT	Knowledge Translation
NRS	The Numerical Rating Scale
NSAID	Nonsteroidal Anti-Inflammatory Drug
PACU	Postanesthesia Care Unit
PNKAS	Pediatric Nurses' Knowledge and Attitude Survey Regarding Pain
PNKAS-N	Pediatric Nurses' Knowledge and Attitude Survey Regarding Pain–Norwegian version
PONV	Postoperative Nausea and Vomiting
RCT	Randomized Controlled Trial
TIDieR	Template for Intervention Description and Replication
UNCRC	The United Nations Convention on the Rights of the Child

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1 INTRODUCTION

In Norway, about 350,000 children are admitted to hospitals every year (1), and many need surgical procedures. Pain management is essential in postoperative care (2, 3). However, postoperative pain in children is underestimated and undertreated (4, 5). The consequences of unrelieved pain can lead to unnecessary suffering (6), increased risk of complications (7), and chronic postsurgical pain (8).

Pain management requires a multidisciplinary approach, but nurses working in Postanesthesia Care Units (PACUs) play an important role in caring for, preventing, and relieving pain in children after surgery. It is essential that PACU nurses have the knowledge, skills, and willingness to help children cope and relieve pain. Several studies have shown that nurses working in pediatric wards lack knowledge about pediatric pain management (9) and that pain management does not conform to the guidelines (5). During the last decade, there has been an increased focus on how to improve pediatric postoperative pain management, and before the present study was conducted, some educational intervention studies were published (10-16). However, they had small samples (10, 12, 13, 15, 16), only one had a control group (14), and none were done in PACUs nor explored the children's experiences of pain and pain management. Nevertheless, in-depth knowledge about pediatric postoperative pain management in PACUs is lacking. This study provides knowledge that is important to nurses working with children in PACUs and universities who educate nurses and specialized nurses.

The overall aim of this thesis was to gain a broader insight into pediatric postoperative pain management in PACUs in Norway, and to determine the feasibility and effect of a tailored educational intervention.

We used three different methodological approaches: a survey (Pediatric Nurses' Knowledge and Attitude Survey Regarding Pain–Norwegian version [PNKAS-N]) to measure nurses' knowledge and attitudes regarding pediatric pain, nonparticipant observation to measure nurses' clinical practice, and individual interviews with children to explore children's views on pain and postoperative pain management.

1.1 Thesis Outline

This thesis consists of seven chapters, a reference list, substudies (I-III) and appendices. After the introduction in Chapter 1, Chapter 2 presents an overview of the central concepts and a

review of the literature most relevant to this study. Chapter 3 presents the aims of this study, and Chapter 4 presents the study design and a detailed description of the methods. Chapter 5 presents the main results of the three substudies. In the first part of Chapter 6, the methodological approaches are discussed, followed by discussions of the main findings, ethical considerations, and a summary of the strengths and weaknesses of the study. Chapter 7 consists of concluding marks with implications for clinical practice and further research.

2 BACKGROUND

This chapter presents an overview of the concepts central to this study, and a review of the literature relevant to this study.

2.1 Central Concepts

The following chapter provides an overview of the study background by describing the ethical and legal situations of hospitalized children in Norway, pain and postoperative pain management, PACU nurses' roles and responsibilities, and the knowledge translation (KT) and implementation frameworks used in this study.

2.1.1 Hospitalized Children

Many children are admitted to the hospital to undergo surgical procedures. Hospitalization might involve interruptions of their routines and meeting unfamiliar people in an unknown environment, and children may experience it as stressful and emotionally devastating (17).

The United Nations Convention on the Rights of the Child (UNCRC) is a human rights treaty that sets out the civil, political, economic, social, health, and cultural rights of children (18). Norway ratified the UNCRC in 1991, and in 2003, the convention was incorporated into Norwegian law (19). This convention includes, among many things, a statement that the child shall receive the highest attainable standard of health and treatment of illness, and in all action concerning children the best interest of the child shall be a primary consideration. Furthermore, children are not to be separated from their parents against their will unless separation is necessary and in the best interests of the child (18).

In Norway, we also have a Regulation on Children's Stay in Hospital, which ensures that children who are hospitalized are admitted to children's wards in a child-friendly environment. Further, it states that healthcare professionals must have knowledge about children's developmental stages and needs, and that parents can stay together with the child (20). Furthermore, Norway has a law about patient rights that includes patient's rights to receive individualized information that is adjusted to the patient's age, maturity, experience, and cultural and language background (21).

2.1.2 Pain and Pediatric Postoperative Pain Management

Pain

In July 2020, the International Association for the Study of Pain (IASP) published its revised definition of pain: "An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (22). The main change in this new definition compared to the 1979 version is that it replaces terminology that relies on a person's ability to describe the pain experience. Together with this definition, the IASP Task Force published six key points to better convey the nuances and complexity of pain, with the hope that it will lead to the improved assessment and management of those in pain (23). One of these six notes highlights that pain is always a personal experience that is influenced to varying degrees by biological, psychological, and social factors (22). Furthermore, the key points elaborate that a person's report of pain should be respected, and that verbal description is only one of several behaviors to express pain (ibid).

As late as the 1980s, premature and newborn children underwent surgery without the necessary analgesia (24). Surgery in neonates can lead to prolonged pain and hypersensitivity in the surgical area (6, 25), and deleterious effects on pain response and neurodevelopmental outcomes have been described (26). Undertreated pain after surgery can lead to unnecessary suffering and increase the risks of complications, morbidity, and mortality, as well as longer hospital stays (7). Unrelieved pain may increase distress (6) and pain response (27-29). A long-term consequence of inadequate relief can lead to chronic postsurgical pain for 20% of children 12 months after surgery (8).

Pain Experience

Pain is described as a biopsychosocial phenomenon (22). Several factors affect children's pain experience, such as biological factors (e.g., age, cognitive development, genes, and temperament), psychological factors (e.g., fear, anxiety, past pain experiences, catastrophizing), and social factors (e.g., cultural conditions, gender, family learning, and expectations of coping with pain). Children who undergo the same surgical procedure can therefore experience pain differently. Healthcare professionals' attitudes, knowledge, myths, and expectations will influence children's pain experiences (30).

Pain Assessment

Assessment and management of pain are essential components of pediatric care for hospitalized children. The evaluation of pediatric pain includes determining the underlying type, source, location, and severity of pain (3). In children, it can be challenging to identify the presence and severity of pain, and then to treat the pain. The use of assessment tools based on cognitive ability is important to ensure that children of all ages receive adequate pain management (3). The general principles of pain management in children include regular pain assessments, which should be made throughout the course of treatment (3, 31) and which should include self-reports whenever possible (3). Several pain assessment tools can be used to assess children: behavioral scales (e.g., the Face, Legs, Activity, Cry, Consolability Scale [FLACC]), face scales (e.g., the Faces Pain Scale–Revised [FPS-R]), and numerical scales (e.g., the Numerical Rating Scale [NRS]) (32-34). However, no single tool is suitable for children of all ages (35, 36).

Postoperative Pain Management

The main goals of pediatric pain management are to prevent, control, and reduce pain (2, 3, 30, 37). Management varies depending on the type, source, severity, and duration of pain. In some cases, treating the underlying source of pain or other related symptoms, such as distress or anxiety, can relieve the symptoms. Even if specific therapy is available to treat the underlying source of pain, it is also important to provide adequate therapy to relieve pain and suffering (3).

The general principles of pain management in children include modifiable management based upon the clinical setting, such as the child's current pain medication regimen and prior experience with pain medications, including adverse effects, parental experience, and fears regarding the use of pain medications (3). Pain management includes both nonpharmacological and pharmacological management (2, 3, 38).

Nonpharmacological Pain Management

Nonpharmacological management (e.g., physical, behavioral, cognitive, and supportive therapies) should be provided for children undergoing painful procedures and/or those who require pharmacologic management (3). The general principles of pain management in

children include taking into account previous use of nonpharmacologic interventions, the child's coping skills, and social and spiritual factors.

Nonpharmacological pain management includes physical measures (e.g., massage, acupuncture, and heat and cold stimulation), behavioral measures (e.g., exercise, operant conditioning, relaxation, biofeedback, desensitization, and art and play therapy), and cognitive measures (e.g., distraction, imagery, hypnosis, and psychotherapy) (3). Distraction techniques should be age appropriate, such as non-nutritive sucking (infants), bubble blowing, listening to a book, interactive toys, playing music through headphones, video games, videotapes, and virtual reality (39-42).

Nonpharmacological management is particularly useful in reducing stress and anxiety in children undergoing invasive procedures (3), and using tablets and handheld devices with interactive capacities can be effective in reducing preoperative anxiety in children (43, 44). Music intervention may also have a beneficial effect on anxiety and reduce pain (41, 45-47).

For preterm and term neonates, nonpharmacologic approaches like breastfeeding (48), non-nutritive sucking (49), sucrose (50) or sweet-tasting solutions, swaddling, or facilitated tucking (49), rocking/holding (49), sensorial saturation, and skin-to-skin contact (51) can effectively reduce pain and discomfort. The use of sucrose and skin-to-skin contact have additive or synergistic effects when combined (2).

Pharmacological Pain Management

Multimodal pain management strategies should be used to treat postoperative pain in children (30, 38, 52). Multimodal analgesia acts synergistically for more effective pain management with fewer side effects and includes basic analgesia (e.g., acetaminophen [paracetamol] and nonsteroidal anti-inflammatory drugs [NSAIDs]), opioids (e.g., morphine), adjuvant analgesics (e.g., gabapentin or clonidine), and regional anesthesia (e.g., neuraxial infusion or peripheral/plexus nerve block) (52). Paracetamol given intravenously is more effective than orally because there is no first-pass metabolism or delay in absorption, and rectal administration has slow and variable absorption (53). Paracetamol reduces pain after surgery (54) and may also reduce the total need for morphine following major surgery (55). Ibuprofen is the most frequently used NSAID for children in Norway. Other commonly used NSAIDs are diclofenac and ketorolac (30).

The choice of opioid is based on the intensity and duration of pain, the preferred mode of administration, the associated adverse effects, and prior experience (if available). For children with acute pain who are opioid naive, short-acting agents are generally preferred over long-acting or extended-release preparations. Morphine is the first choice of opioid used for children in PACUs in Norway (30). Intravenous opioids may be warranted for severe acute pain (3). Common adverse effects of opioids are nausea and vomiting, constipation, sedation, cognitive dysfunction, respiratory depression, and pruritus (ibid.). The side effects of analgesic agents should be anticipated and treated appropriately (3, 30).

IASP has developed a fact sheet that states what healthcare professionals should know about pain after surgery (7). Healthcare professionals should know that most pain after surgery can and should be managed. Further, it includes assessing pain intensity at rest and with relevant activity, identifying in advance those patients who may require special attention, integrating pain control when preparing and recovering from surgery, a multimodal approach, monitoring, and organizing pre-, peri-, and postoperative pain management. According to the IASP, healthcare professionals should reduce or avoid the following adverse effects of undertreated postoperative pain: unfavorable patient experiences, undesired clinical outcomes, and costly administrative burdens (ibid.).

2.1.3 PACU Nurses' Roles and Responsibilities

The purpose of the Norwegian Health Personnel Act is to ensure patient safety and quality within the health service (56). Healthcare professionals shall act in accordance with their professional qualifications and should seek assistance or refer patients further where necessary and possible (ibid.).

In PACUs in Norway, the staff consists of nurses and specialized nurses (e.g., critical care nurses and some pediatric nurses). The International Council of Nurses Code of Ethics for Nurses (57) states that nursing must be based on research, experience-based competence, and user knowledge. The nurse should enhance the patient's ability to make independent decisions by providing adequate, adjusted information and ensuring that the information is understood. The nurse is responsible for relieving suffering. Further, the nurse should provide children and parents with the information they are entitled to receive (ibid.). Critical care nurses' functions and responsibilities involve the following: preventing complications and injury, assessing personal resources, maintaining or creating the approximately normal functioning of

patients, relieving stress, discomfort, and pain, taking care of autonomy and integrity, and being familiar with patient rights (58). Pediatric nurses' functions and responsibilities include treating, preventing complications, and relieving suffering, pain, and discomfort in children (59). Pediatric nurses must have knowledge about children's physical, mental, and social development (ibid.).

The PACU nurses' responsibilities regarding postoperative pain management in children are to recognize, assess, prevent, and treat pain (2, 3, 30, 37). They should use strategies to reduce children's anxiety (60), actively involve children, and help them cope (61). Effective communication with children requires using language appropriate to the child's age (62). Therefore, PACU nurses caring for pediatric patients need to have a basic understanding of these age-specific characteristics when caring for each age group (63). Understanding these age-specific characteristics is important because providing developmentally appropriate care for children may decrease their anxiety in the perioperative setting and improve outcomes (63). Pain assessment is influenced by how nurses communicate with children about pain, how they ask children, and whether they expect children to tell them when they are in pain. Further, pain assessment and communication will be influenced by whether nurses are able to gain children's trust, and if, for example, they are aware of preschoolers' highly literal interpretation of words and lack of ability to think abstractly. PACU nurses need to gain children's trust and help them cope.

2.1.4 KT and Implementation Frameworks

Translating Knowledge

Healthcare systems are struggling to deliver evidence-based practice (EBP) (64). Ensuring that evidence is used in clinical practice requires paying attention to KT, which is described as a process that reduces the gap between research and practice through the dissemination and exchange of research evidence and its application to clinical practice to improve health outcomes, quality of care, and healthcare systems (65). KT strategies (e.g., reminders, educational materials, educational outreach, and audit and feedback), can be effective in promoting healthcare professionals' use of clinical research evidence to enhance clinical practice and improve clinical outcomes (66). There are different formats of KT that can be used: for example, in-service/workshop, informal training, implementation of guidelines or protocols, changes to charts, prescription forms, or unit materials, handouts/pocket cards,

simulations/case studies, posters and/or bedside cards, audits, distribution of journal articles/references, and focus groups/staff discussions. In-service or workshop and informal training are reported to be used more often (67). Tailored KT strategies in the unit context, support from unit leaders, staff engagement, and dedicated time and resources have been identified as facilitating the effective implementation of these strategies (66).

Implementation Frameworks

There are many different implementation frameworks (68). Different implementation frameworks serve different purposes, such as to describe or guide the implementation process (e.g., the Knowledge of Action Framework) (69), to identify determinants of implementation (e.g., the Consolidated Framework for Implementation Research [CFIR]) (70), to evaluate implementation (e.g., Reach Effectiveness Adoption Implementation Maintenance) (71), or to report implementation (e.g., the Template for Intervention Description and Replication [TIDieR] and the Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching [GREET] checklist) (72). A brief description of the different frameworks used in this thesis is presented below.

The Consolidated Framework for Implementing Research (CFIR) serves to identify the determinants of implementation and provides a pragmatic structure for approaching complex, interactive, multi-level, and transient states of constructs by embracing, consolidating, and unifying key constructs from published implementation studies (70). The CFIR consists of five domains: the intervention (intervention source, evidence strength and quality, relative advantage, adaptability, trialability, complexity, design, quality, and packaging cost), inner setting (structural characteristics, networks, and communications, culture, implantation climate), outer setting (patient needs and resources, cosmopolitanism, peer pressure, external policies and incentives), the individuals involved (knowledge and beliefs about the intervention, self-efficacy, individual stage of change, individual identification with organization, other personal attributes) and the process by which implementation is accomplished (planning, engaging, executing, reflecting and evaluating) (70).

Standardized reporting of implementation strategies, such as the TIDieR (73), may help increase the likelihood of implementation research fidelity (74). The TIDieR is a checklist and guideline developed to improve the reporting of intervention in research, and contains 12 items for better describing an intervention, and where to find this information for example in

an article. The TIDieR is a supplement to the CONsolidated Standards of Reporting Trials (CONSORT) 2010 guideline (73). The CONSORT 2010 guideline is intended to improve the reporting of randomized controlled trials (RCT) and help readers to understand a trial's design, conduct, analysis, and interpretation and to assess the validity of its results (75). The CONSORT extension for cluster trials was updated in 2012 to align with CONSORT 2010 and contains a 25-item checklist and flow diagram template.

The GREET checklist consists of 17 recommended items for reporting EBP in educational intervention (72). The GREET checklist (brief name; why and what; who provided; how, where, when, and how much; planned changes and unplanned changes; and how well) is a reporting guideline designed to provide a framework for consistent and transparent reporting for educational interventions for EBP (72).

2.2 Review of the Research

In this section, the relevant literature for this thesis is reviewed. The present study was based on research literature published at the time the study was initiated in 2014. Ongoing and updated literature searches were conducted during the study period and while the thesis was being written. The empirical foundation of this thesis is based on research literature published up to and including November 2022 (Appendix 10). This thesis refers to previous studies (published before 2014) and more recent studies (published after 2014).

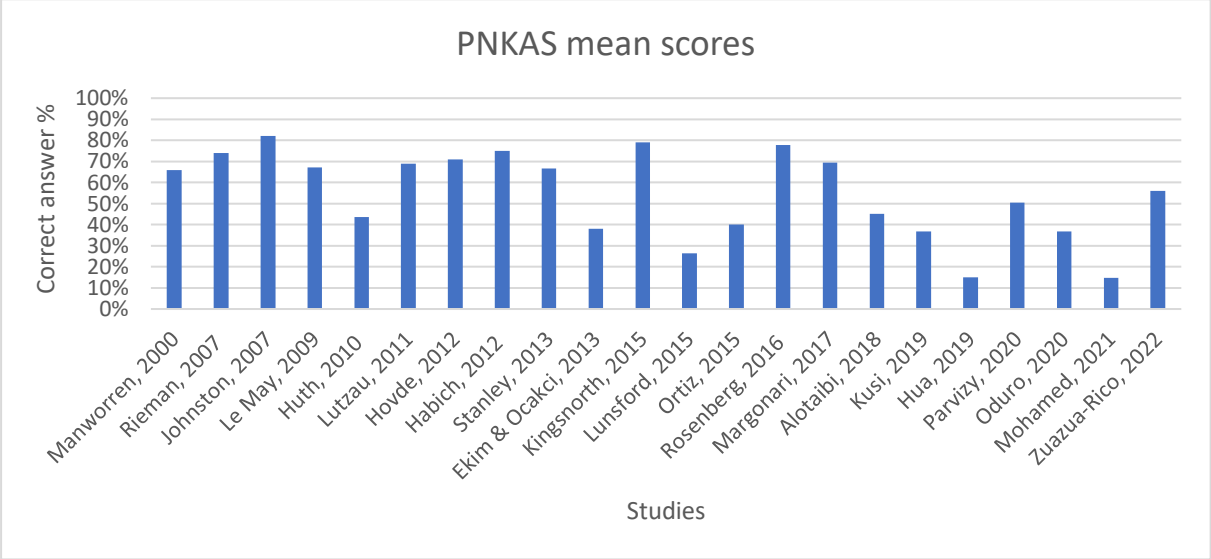
2.2.1 Nurses' Knowledge and Attitudes Regarding Pediatric Pain

Previous studies have shown that nurses have poor knowledge about and attitudes toward basic pediatric pain assessment and management principles (9). Nurses' knowledge and attitudes regarding pediatric pain management have been identified using the Pediatric Nurses' Knowledge and Attitude Survey Regarding Pain (PNKAS) in several *previous* studies (76-81), conducted on nursing students (82), used in intervention studies (12-15), and in more *recent* studies (83-88) on nursing students (89-93), and in intervention studies (94-99).

Results from PNKAS studies of nurses conducted in the Kingdom of Saudi Arabia (83), Ghana (84, 85), Turkey (76), Mexico (13, 87), Egypt (97), China (88), Mongolia (95) and Iran (98) showed low total mean scores, with < 50% correct answers. Studies conducted in the USA (12, 78-80, 96, 99), Canada (14, 15, 94), Norway (77), Spain (86) and Germany (81) showed higher total mean scores, with 56–82% correct answers. None of these studies, except

one (14), found a mean score of > 80%, which is often set as the acceptable level of knowledge (84). The mean scores of the PNKAS studies are summarized in Figure 1.

Figure 1 PNKAS Studies



Findings from these studies demonstrated knowledge deficits in pharmacological issues, such as useful drugs for pain treatment in children (12, 76-80, 83), risk of addiction (76, 77, 80, 81, 83, 85-87, 96), risk of respiratory depression (12, 76-81, 83, 86, 96), conversion of morphine doses from intravenous to oral administration (12, 76-79, 84, 85, 96) and other items, including that children may sleep in spite of severe pain (77, 83, 86) and that children over-report pain (76-78, 80, 83-85, 96).

2.2.2 Nurses' Pediatric Postoperative Pain Management Clinical Practice

Pain assessment and postoperative pain management in children have been examined using chart reviews in many *previous* studies (12, 14, 100-108) and more *recent* studies (66, 109-117). Two of these studies were conducted in PACUs (113, 115). Findings from these studies demonstrate high (94%–69%) pain prevalence in hospitalized children (103, 110-112, 114, 116, 118) and that many children (24%–70%) experience moderate to severe pain (100, 102, 103, 105, 107, 109, 111-114, 116-118). Some studies showed that 50% of the children with a high pain intensity score did not receive pain medication (114) and that 75% of the children received a pharmacologic intervention that was too low according to the analgesic ladder (12). Some studies showed a low prevalence (27%–58%) of documented pain assessment (14, 106, 107, 111, 114, 117, 118). In particular, two studies found a higher prevalence (69–86%) of documented use of pain assessment tools (112, 115), but low use (19%) of valid pain

assessment tools (115). Further, they reported a low prevalence of documented use of nonpharmacological pain management (14, 103), that pain management was not systematically administered to prevent or treat pain (100, 117), and that when regular paracetamol was prescribed, only 88% of the nurses administered paracetamol (104). Finally, these studies found that 44% of the children experienced postoperative nausea and vomiting (PONV) (112) and that pediatric pain management did not concur with hospital policies or unit protocol (101, 106, 111).

Only a few studies have explored nurses' pediatric postoperative pain management by observing them in clinical practice (119-123). These studies revealed that practice did not conform to current recommendations in most areas (120), that nurses' overall aims of postoperative pain management in children did not match their clinical practice (122), that nurses did not routinely assess pain (120, 123) or reassess pain when the pain score was ≥ 5 (121), that pain score did not guide the treatment choice (121), that pain management practice was suboptimal (120), that nurses were reluctant to give opioids (119, 121), that pain medication was given regularly, even if it was prescribed *pro re nata* (121), and that use of nonpharmacological pain interventions was limited (120, 121, 123). However, another study by Twycross and Collis (123) revealed that practice conformed to current hospital guidelines in some areas, and when analgesics were prescribed, it conformed to guidelines and were usually administered as prescribed.

2.2.3 Children's Experience of Pain and Postoperative Pain Management

Nurses' assessment and management of children's pain are not consistent with published guidelines (5), and many children experience moderate to severe pain (4, 5, 124). Recent studies from Denmark (117), USA (111, 113, 114), Canada (110), Austria (109) and Thailand (116) revealed that 25%–50% of the children experienced moderate to severe pain.

Some *previous* studies have explored children's perceptions of acute pain (125-128) and postoperative pain management (129-136), and a more *recent* study (137). These studies showed that children can express their pain experiences in terms of causes, locations, and quality (125, 126). Pain experiences include both physical and psychological dimensions, and are influenced by their previous pain experiences, expectations, and sociocultural factors (125). Children use many cognitive/behavioral and sensory/physical self-soothing strategies

to relieve pain (126-128). Furthermore, they rely on others (nurses and parents) to be present and help them relieve their pain (126, 127).

Children's perceptions of postoperative pain have been explored in some *previous* studies from the USA (134, 136), Canada (135), Australia (129), Singapore (133), China (130), Finland (131) and Sweden (132, 137). These studies all support the notion that children continue to experience moderate to severe postoperative pain. In a study by Rullander *et al.* (137) several children reported persistent pain 5–12 months after surgery. Children described a range of negative emotions, including anger, fear, and sadness, in relation to their experiences with postoperative pain (129, 132, 133, 135). For some children, nausea is worse than pain (129, 132). In a study by Ford *et al.* (129), the children reported no use of pain assessment tools during their hospital stays.

Children used different strategies to relieve postoperative pain, such as taking medicine, sleeping, resting, and distractions (129, 131, 134). Children reported that pharmacological pain management was the most effective way to relieve postoperative pain (130, 133, 134, 136). Some children were reluctant to take medicine because it tasted bad, because it was difficult or hurt to swallow, or because they became nauseous (129, 134). They stated that the most important thing parents could do to help them cope with their pain was to be present with them in the hospital (130, 133, 136). Some children reported receiving inadequate preoperative information (129, 134, 135).

Children also have suggestions for nurses to improve their postoperative pain management: improved communication between nurses and parents, so that parents have enough knowledge to deal with their child's pain (130), more use of distraction and positioning (133), creating a more comfortable environment and arranging more meaningful activities (131), to check on the children more often (135), and giving more or stronger pain medication without delay (131).

2.2.4 Educational Intervention Studies Regarding Pediatric Pain Management

The effectiveness of educational interventions in pediatric pain management has been explored in *previous* studies (10-16, 138) and in more *recent* studies (94-99, 139-143). These studies investigated nurses' knowledge, clinical practice, and children's views regarding pain management (Table 1).

Nurses' Knowledge of Pediatric Pain Management

Some of these studies measured nurses' knowledge regarding pediatric pain management using PNKAS (12-16, 94-99) or other questionnaires (10, 11, 98, 138, 139, 141-143). Studies using PNKAS showed improved knowledge and attitude (13, 15, 16, 94-99). One study did not find improved knowledge and attitude (12), and Johnston *et al.* (14) found improvement in the intervention group, but the difference was not significant compared to the control group, and there were significant site differences (Table 1).

Nurses' Pediatric Postoperative Pain Management Practices

Some studies have measured nurses' pediatric postoperative pain management practices by using chart review (10-12, 14, 16, 142) or observing clinical practice (143). These studies showed improvement in the documentation of patient care (10), documented use of pain assessment tools (11, 12, 16) and improved pain assessment skills in the intervention groups (143). However, Heinrich *et al.* (142) did not find increased use of pain assessment tools, and Johnston *et al.* (14) found increased documented use of tools in the coaching group, but that this was not significant compared to the control group. Vincent *et al.* (16) conducted a pilot intervention study that showed significant improvement in nurses' beliefs and documented pain management practices. Johnston *et al*. (14) found increased documented use of nonpharmacological interventions in the coaching group, but that this was not significant compared to the control group. However, Heinrich *et al.* (142) found no significant increase in the use of nonpharmacological interventions. Some studies found increased use of analgesics (16, 142), where Vincent *et al.* (16) found increased use of NSAIDs. On the other hand, Johnston *et al.* (14) found no significant change in documented analgesic administration after the intervention (Table 1).

Children's Perspectives on Pain Assessment and Management

A few studies have explored children's views on pain assessment and management by using questionnaire and diary (140, 142). Children reported increased use of analgesics and significant improvement in nurses asking regularly about pain (142). In a study by Zhu *et al.* (140), where the educational intervention targeted parents and their children, the parents increased their knowledge and use of nonpharmacological pain-relieving techniques (Table 1).

Table 1 Previous Educational Intervention Studies in Pediatric Pain Management

Published Prior to Present Study (Previous Studies)						
Author (Year) Country	**Design, Participants, Sample Size**	**Measures**	**Intervention Frequency & KT Format**	**Findings: Knowledge**	**Findings: Pain Assessment**	**Findings: Pain Management**
Abdalrahim et al. (2011) (10) Jordan	Pre–post, no control group Single-center study (1 hospital) Nurses T1 = 65, T2 = 65	Questionnaire, chart review T1 = 120, T2 = 120	*Intervention Frequency* Postoperative pain management program, 3-month program, 2-day in-service educational program *KT Format* In-service/workshop Practical skills training Group discussion Role-play/vignette Feedback/test Ongoing support	Significant improvement in knowledge and attitude Significant improvement in most of the items (15 of 21)	N/A	Significant improvement in the documentation of patient care in most of the audited patients' records
Ellis et al. (2007) (11) Canada	Pre–post, no control group Single-center study (1 hospital) Nurses and physicians T1 = 75, T2 = 44	Questionnaires, chart review, focus groups Focus groups with 366 nurses and 8 physicians Chart review T1 = 75, T2 = 44	*Intervention Frequency* Workshop, 4 hours *KT Format* In-service/workshop Informal training Guidelines Handouts Experts-on-call/change champion Simulation/role-play Audits Posters/bedside cards Focus group/discussions	Improved knowledge	Significantly increased documented use of pain assessment tools	No change in beliefs No change in opioid orders or doses
Habich et al. (2012) (12) USA	Pre–post, no control group Single-center study (1 hospital) Nurses T1 = 27, T2 = 11, T3 = 15	PNKAS, chart review	*Intervention Frequency* Unspecified *KT Format* In-service/workshop Guidelines	No significant improvement in knowledge and attitude	Significant documented improvement in the use of pain assessment tools	N/A
Huth et al. (2010) (13) Mexico	Pre–post, no control group Multicenter study (3 hospitals) Nurses T1 = 106, T2 = 79	PNKAS	*Intervention Frequency* Pediatric pain education program (PPEP), 4 hours *KT Format* In-service/workshop Simulation/role-play	Significant improvement in knowledge and attitude	N/A	N/A
Johnston et al. (2007) (14) Canada	Pre–post, control group Matched-pair cluster design Multicenter study (6 hospitals) Pediatric nurses T1 = 141, T2 = 90	PNKAS, chart review	*Intervention Frequency* One-on-one coaching based on audit with feedback, 10 sessions Unspecified *KT Format* Informal training Coaching Written information Audit with feedback	Increased knowledge of the intervention group, not significant	Increased documented use of pain assessment, not significant	Increased documented use of pharmacological and nonpharmacological, not significant
Le May et al. (2009) (15) Canada	Pre–post, no control group Single-center study (1 hospital) Pediatric nurses T1 = 42, T2 = 21	PNKAS, chart review Chart review (150/150/150)	*Intervention Frequency* Workshops, 1–3 hours 2 short capsules (20–30 minutes) *KT Format* In-service/workshop Handouts	Significant improvement in knowledge and attitude	Improved documentations of pain	No improvement in documented use of analgesic No improvement in documented use of nonpharmacological T1 and T2, but increased use of T1 and T3
Textor & Porock (2006) (138) Colombia	Pre–post, no control group Single-center study (1 hospital) Nurses T1 = 46, T2 = 46, T3 = 35	Questionnaire	*Intervention Frequency* Pain education program, 4 hours *KT Format* In-service/workshop Handouts Focus groups/staff discussions	Significant improvement in knowledge and attitude	N/A	N/A
Vincent et al. (2011) (16) USA	Pre–post, no control group Single-center study (1 hospital) Intervention pilot Nurses T1 = 24, T2 = 21	Modified PNKAS, questionnaires, chart review	*Intervention Frequency* RCP program, 2 hours Internet-based RCP (relieving children's pain) *KT Format* In-service/workshop Simulation/case study	Significant improvement	Significant decrease in children's pain score	Significantly more administration of NSAID

Published After the Present Study Commenced (Recent Studies)						
Author (Year) Country	**Design, Participants, Sample Size**	**Measures**	**Intervention Frequency & KT Format**	**Findings: Knowledge**	**Findings: Pain Assessment**	**Findings: Pain Management**
Dongara et al. (2017) (141) Western India	Pre–post, no control group Single-center study (1 hospital) Nurses T1/T2 = 90/87	Questionnaire	*Intervention Frequency* Workshop, 3 hours	Significant improvement	N/A	N/A
Farahani et al. (2014) (143) Iran	Pre–post, control group Multicenter (2 hospitals) Randomized by hospital Nurses T1 = 64 (30/ 34)	Questionnaire, observations (checklist)	*Intervention Frequency* Workshops (5 sessions) Clinical training (1 week) 3 months *KT Format* In-service/workshop, Informal training, Experts-on-call Changes to forms/charts	Nurses in the intervention groups scored significantly higher than those in the control group (pain assessment)	Significant improvements in nurses' skills in questioning children and parents about pain and nurses' skills in the use of pain assessment tools	N/A
Heinrich et al. (2016) (142) Germany	Pre–post, no control group Single-center study Nurses, children/parents T1 = 93 patients T1 = 44 nurses T2 = 85 patients T2 = 39 nurses	Questionnaire, chart review children (> 10 years, and parents when children < 10 years)	*Intervention Frequency* Unspecified 3 years In-house training Conceptual changes *KT Format* Informal training Handouts/pocket cards Changes to forms/charts	N/A	No increased use of tools No improved knowledge in use of tools Patient reported increased improvement in asking regularly about pain	Improved administration of analgesics No increased use of nonpharmacological pain therapies Patient reported faster administration of analgesics and improved pain relief
Kingsnorth et al. (2015) (94) Canada	Pre–post, no control group Single-center study (1 hospital, 3 units) Nurses T1 = 69, T2 = 49	Modified PNKAS, chart reviews Chart review (n = 108) T1 = 35 children T2 = 33 children T3 = 40 children	*Intervention Frequency* 3 tailored education modules, 1 hour each *KT Format* In-service/workshop, Coaching, Changes to charts, prescription forms, or unit materials , Campaign, Pain assessment tools, Handouts/pocket cards , Focus groups/staff discussions	Significant improvements in nurses' knowledge, attitudes	Significant reduction in pain score between T1 and T3, and T2 and T3 No significant improvement between T1 and T2	Significant improvements in behaviors related to optimal pain care for children with disabilities
Lunsford (2015) (95) Mongolia	Pre–post, no control group Single-center study (1 hospital) Pediatric nurses T1 = 167, T2 = 155	Modified PNKAS	*Intervention Frequency* Educational intervention, 2–2.5 hours *KT Format* In-service/workshop	Significant improvement in knowledge and attitude	N/A	N/A
Margonari & Hannan (2017) (96) USA	Pre–post, no control group Pediatric nurses T1 = 20, T2 = 19, T3 = 8	PNKAS, chart review	*Intervention Frequency* Educational intervention, 30-minute face-to-face slide presentations and discussions 5 sessions *KT Format* Implementation of guidelines or protocol, Changes to charts, prescription forms, or unit materials, Handouts , Focus groups/staff discussions	Significant improvement	Increased documented use of pain assessment Increased documented use of developmentally appropriate pain scale	N/A
Mohamed Thabet et al. (2021) (97) Egypt	Pre–post, no control group 2 groups: multimedia (n = 23) vs. lecture (n = 22) Pediatric nurses T1 = 45	PNKAS	*Intervention Frequency* Lecture group, educational session with PowerPoint (PP), 3 hours *KT Format* Handouts (booklet), Focus groups/ staff discussions, Simulations/ case studies, Demonstration of pain assessment tools	Both groups increased knowledge and attitude Higher in the multimedia group	N/A	N/A
Mousa (2019) (139) Sudan	Pre–post, no control group Multicenter study (5 hospitals) Pediatric nurses T1 = 169, T2 = 169	Questionnaire	*Intervention Frequency* Lecture and small-group discussion *KT Format* Lecture Small-group discussion	N/A	Significant changes in knowledge about use of pain assessment tools	N/A
Parvizy et al. (2020) (98) Iran	Pre–post, control group Multicenter study (2 hospitals) Nurses T1 = 60 (30/30)	PNKAS, questionnaire (Nurses' Self-Efficacy in Pain Management)	*Intervention Frequency* 3 workshops, 4 hours each *KT Format* In-service/workshop, Focus groups/ staff discussions, Simulations/ case studies	Increased knowledge and attitude	N/A	N/A
Rosenberg et al. (2016) (99) USA	Action research Single-center study (1 medical center) Nurses and physicians T1 = 115	PNKAS, chart review	*Intervention Frequency* Unspecified Over 18 months *KT Format* Change champions/ role, models/ experts-on-call , Informal training Changes to charts, prescription forms, or unit materials , Handouts/pocket cards	Significant improvement	N/A	Increased use of topical lidocaine
Zhu et al. (2018) (140) Singapore	Pre–post, control group (RCT) 3 groups Parent–child (6–14 years old) pairs T1 = 152	Questionnaire (parents), chart review, diary	*Intervention Frequency* Intervention: 1 hour (face-to-face) *KT Format* Booklet, Video, Lecture	Significantly improved knowledge (parents)	N/A	Significantly improved use of nonpharmacological (parents) No significant differences among groups regarding pain management and use of pain medication

2.2.5 Summary

Norwegian laws and regulations ensure that hospitalized children are admitted to a child-friendly environment where their parents can be together with them. Further, healthcare professionals must be knowledgeable about children's developmental stage and needs, and give them the highest attainable standard of treatment.

Every day, many children undergo surgery and experience pain. Pain is a personal experience that is affected by biopsychosocial factors, such as healthcare professionals' attitudes and knowledge, myths, and expectations. Unrelieved pain may lead to unnecessary suffering, increased risk of complications, and, for some, chronic postsurgical pain. PACU nurses play an essential role in pediatric postoperative pain management and have a responsibility to recognize, assess, prevent, and treat pain. Pain management includes regular pain assessment and the use of both pharmacological and nonpharmacological pain-relieving strategies.

Previous research shows that nurses working in pediatric wards lack knowledge of basic pediatric pain management topics, that pediatric patients experience a high prevalence of pain after surgery, and that there is a low documented use of valid pain assessment tools and nonpharmacological pain relief techniques.

However, from previous research, we do not know about PACU nurses' knowledge and attitudes regarding pediatric pain management. Furthermore, no studies have investigated how nurses practice postoperative pain management by observing them or the children's experiences of postoperative pain management in PACUs by interviewing them. A few intervention studies have been conducted. However, none have evaluated whether tailored educational interventions for PACU nurses will improve knowledge and clinical practice by using surveys, observational studies, and interviews with children.

Therefore, we wanted to explore pediatric postoperative pain management in PACUs by conducting a cluster randomized design, measuring PACU nurses' knowledge and attitudes (via PNKAS), clinical practice (via observation), exploring the children's experiences (via interviews), and determining the feasibility and effects of a tailored educational intervention.

3 AIMS OF THE STUDY

The overall aim of this thesis was to gain a broader insight into pediatric postoperative pain management in PACUs, and to determine the feasibility and effects of a tailored educational intervention. The specific aims of the included substudies were as follows:

I To identify nurses' knowledge, attitudes, and clinical practice regarding pediatric pain management in PACUs and to determine whether there is a link between knowledge and actual practice, using a combination of methodological approaches to obtain new information in this context (Substudy I)

II To explore children's experiences with pain and postoperative pain management in PACUs. With the overarching goal of influencing future clinical practice, we sought to gain a greater understanding of children's experiences and to gather their recommendations for improving postoperative pain management (Substudy II)

III To assess whether a tailored educational intervention for nurses working in Norwegian PACUs increased their knowledge and attitudes regarding pediatric pain management and improved actual postoperative pain management in an intervention group compared to a control group (Substudy III)

4 METHODS

4.1 Research Design

The present study uses a cluster randomized design using different methodological approaches (i.e., questionnaire, observational study, and interview) with three measurement points (baseline, one month postintervention, and six months postintervention). The study was conducted in PACUs at six university hospitals in Norway, and participants were cluster randomized by unit, three in the intervention group and three in the control group. The study is registered at ClinicalTrials.gov (Identifier: NCT03385681).

Multiple triangulations were used, including data, investigator, and methodological triangulation, to gain a wider picture of pediatric postoperative pain management. Three different approaches, including qualitative and quantitative measurements, were used to explore pediatric postoperative pain management and to evaluate whether the tailored educational intervention improved nurses' pediatric pain management knowledge, attitude, and clinical practice.

The present study was conducted in three phases. Phase 1 explored pediatric postoperative pain management in PACUs at baseline (T1). Phase 2 developed a tailored educational intervention based on the results from T1 and the available research in the area. Phase 3 implemented and evaluated the effects of the intervention (measured one month after intervention [T2] and six months after intervention [T3]).

An overview of the three substudies is summarized in Table 2. Phase 1 (T1) is presented in Substudies I and II, and Phases 2 and 3 (develop intervention, implement, and measure effect at T2 and T3) are presented in Substudy III.

Table 2 Overview of the Three Substudies

Paper	Design	Aim	Data Collection	Analysis
I	Descriptive cross-sectional study Multicenter (six hospitals)	To identify nurses' knowledge, attitudes, and clinical practice regarding pediatric pain management in PACUs and to determine whether there is a link between knowledge and actual practice, using a combination of methodological approaches to obtain new information in this context	Questionnaire Observation	Descriptive and correlative statistics
II	Qualitative exploratory study Multicenter (two hospitals)	To explore children's experiences with pain and postoperative pain management in PACUs. With the overarching goal of influencing future clinical practice, we sought to gain a greater understanding of children's experiences and to gather their recommendations for improving postoperative pain management	Interviews	Content analysis using Creswell's six-step approach (144)
III	Cluster RCT Multicenter (six hospitals)	To assess whether a tailored educational intervention for nurses working in Norwegian PACUs increased their knowledge and attitudes regarding pediatric pain management and improved actual postoperative pain management in an intervention group compared to a control group	Questionnaire Observation Interviews	Descriptive and correlative statistics, linear mixed models for repeated measures, and ITT principles

4.2 Participants

The study was conducted in the largest PACUs that treat children in each of the six university hospitals covering all health regions in Norway. Five of these units care for both children and adults, and one cares for children only. There were between 30 and 60 nurses working with children in each unit.

The samples included in this study consisted of nurses and children. During each data collection period, all data collection was conducted during the same period in the same units. The children interviewed were also observed when they were in PACUs during the observational study. Inclusion and exclusion criteria were defined for recruiting.

Inclusion Criteria

Questionnaire

- Nurses working with children in the included PACUs

Observational Study of Clinical Practice

- Nurses working with children in the included PACUs who were on duty during the data collection periods
- Children (0–18 years) and their parents admitted to these included PACUs during the data collection periods

Interviews with Children

- Children older than six years going through surgery at the time of data collection periods

Exclusion Criteria

Questionnaire

- Nurses not involved in clinical work
- Nurses working part-time (less than 75%)

Observational Study of Clinical Practice

- Children who did not have surgery

Interviews with Children

- Children not admitted to the included PACUs
- Children with cognitive impairment who were unable to communicate verbally
- Children who did not speak Norwegian

4.3 Tailored Educational Intervention

Using CFIR as a framework and KT strategies, the intervention group received tailored educational intervention developed based on previous research and T1 results obtained from the questionnaire, observations, and interviews with children (Table 3). The intervention was tailored to meet local needs and included lectures, workshops, clinical supervision, deliveries of pain assessment tools, and nonpharmacological equipment.

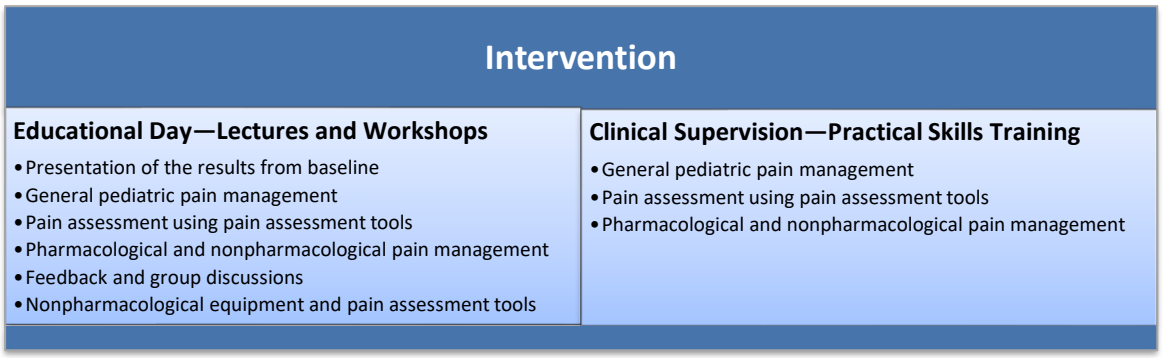
Table 3 The Five CFIR Domains and KT Strategies Used in This Study

Domains	The Present Study
Intervention	The stakeholders in each unit were positive toward the study and saw the intervention as a great advantage that they would receive after baseline measurements. Only three of the six units were randomly chosen to receive the intervention, but all the units wanted to have the

	intervention. The reasons for this were because the intervention group would receive tailored education and clinical supervision, pain assessment tools, and nonpharmacological equipment paid for by the research team. The stakeholders believed that they could learn something from this and that the educational day was offered by well-known pediatric pain management experts. The stakeholders arranged for the nurses to participate during the educational days. The intervention was tailored to each unit based on previous research, the stakeholders' wishes, and baseline results. Because all units wanted the intervention, the units in the control group were promised that they would receive the intervention after the study was conducted.
Outer Setting	Before the study, we did not know the children's views on postoperative pain management in PACUs. Therefore, we conducted baseline interviews with the children. The results were addressed in the intervention. As part of the intervention, the nurses received the results from the interviews during the lecture, and the workshop discussions and clinical supervision targeted these findings. There was no network between the hospitals or units, and because of the lack of national guidelines, the postoperative pain management practices varied greatly between the units. To target this, we supported them with evidence-based knowledge and motivated them to develop local guidelines. Furthermore, we initiated the process with national guidelines.
Inner Setting	The nurses working in PACUs in the intervention group cared for both children and adults with various diagnoses. Nurses and physicians who worked together in the units in the intervention group had no regular meeting points for lectures or seminars. Therefore, we offered an interdisciplinary educational day with workshops and supported them with information using the hospital's internal website and posters.
Individuals involved	Nurses in the included units were experienced, and many were specialized nurses. Most of the participants were enthusiastic and engaged and felt lucky to receive the intervention and learn more. The baseline results showed knowledge gaps and a lack of skills but with great variation between the participants. There were significant differences in the knowledge of the specialized nurses and the nurses with only bachelor's degrees. To target this, we tried to motivate them to engage and improve themselves.
Process	The process included planning, engaging, executing, and reflecting and evaluating (70). The intervention was planned in detail in cooperation with the stakeholders. All nurses and physicians were invited to participate on the educational day. The PhD student had regular contact with the stakeholders, who were to organize and invite the participants to the educational day. Each unit had an implementation team that included unit leaders, physicians, and educators. Although all nurses and physicians were invited to participate in the educational day, not all nurses and a few physicians participated. To change practice, it is very important to engage, reflect, and evaluate (145). During the educational day, the participants received lectures and discussed and worked in multi-professional workshops. Furthermore, during the educational day and clinical supervision, the participants were given the opportunity to evaluate both verbally and written (anonymously). The evaluation showed that participants reported that they found the educational day and clinical supervision useful; they received new knowledge and inspiration.
	KT Goals • Generate awareness and interest • Share knowledge • Facilitate practice and behavior change KT Strategies • Tailored educational intervention • Educational materials • Audit and feedback • Clinical supervision • Implementation team • Reminders
	Implementation Plan • Phase 1—Exploration • Phase 2—Preparation • Phase 3—Implementation & Evaluation Evaluation • Reach indicators (response rate questionnaires, participation on educational day) • Usefulness indicators (evaluation of intervention and clinical supervision) • Use indicators (use of pain assessment tools) • Knowledge & attitude change (PNKAS-N) • Clinical practice change (observational study)

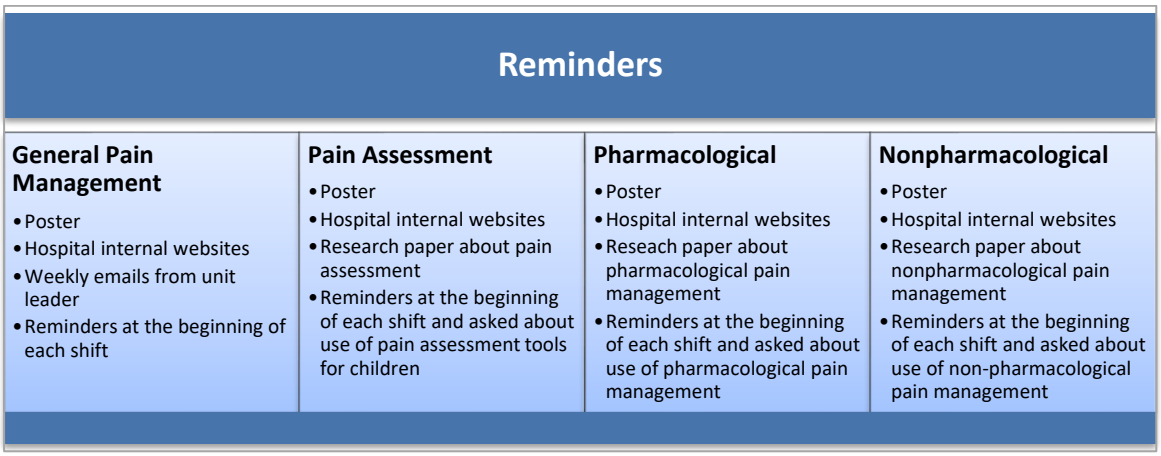
The intervention consisted of a one-day seminar (educational day) for nurses and physicians working at the units (two to four days per unit to ensure all nurses could participate) with lectures and workshops, and parallel sessions for physicians and the nurses tailored to each profession and their needs. The lectures given covered the following themes: general pain management, pain assessment, pharmacological and nonpharmacological pediatric pain management, focusing on the subjects showing the lowest pediatric pain management knowledge, and competence at each unit (Figure 2). After the one-day seminar, all participants were invited to provide an anonymous written evaluation of the seminar. In addition, clinical supervision was offered to nurses in pediatric postoperative pain management (one-to-one for three to six days per unit, depending on the size of the units). After supervision, the participants were invited to provide anonymous written evaluations. The intervention was conducted by experts (nurses and a physician; the same team conducted the intervention at all PACUs in the intervention group) in pediatric postoperative pain management. Further, all nurses were given pain assessment tools for children, and all units received a suitcase of nonpharmacological equipment (e.g., toys, soap bubbles, DVDs) (Figure 2).

Figure 2 Intervention



After the educational intervention, different reminders were provided. The reminders were based on general pain management practice, pain assessment, and pharmacological and nonpharmacological pediatric pain management. In the first month, there were reminders every two weeks, and thereafter every month for six months. The reminders were in different formats (e.g., posters, pamphlets, newsletters, research articles, and focus weeks) posted in different places in the units (Figure 3).

Figure 3 Reminders



The intervention was constructed with the same framework and procedure in each unit but with different content and patient cases from the units. In addition, each unit was presented its own results from T1. Each unit had an implementation team that included unit leaders, physicians, and educators. The PhD student emailed the leaders every week and supported them with reminders.

PACUs in the control group were offered an educational day and pain assessment tools for children after the study was completed.

4.4 Sample Size, Randomization and Blinding

Sample Size

The sample size calculation was based on PNKAS-N, and a difference between the groups of two points with a standard deviation (SD) of four using the PNKAS-N mean score was considered clinically relevant. Given a statistical power of 80% and a significance level of 5% (two-sided test), 128 participants were required. Considering at least a 25% attrition rate at T2 and an additional 10% for cluster randomization, all nurses working with children in the six selected units (n = 258) were invited to participate to ensure that the study was sufficiently powered.

Randomization and Blinding

Six units were included in this study. Nurses were cluster randomized by unit into either an intervention group or a control group. Three units were randomly chosen for the intervention group and three units for the control group. To ensure that the allocation was blinded to the

researchers, each unit was coded with a letter (A, B, C, D, E, F), and each letter was written on one piece of equally sized paper. The pieces were folded so that the letter did not show, put into a box, and mixed. Then, the PhD student drew the pieces from the box to assign units to either the intervention or control groups. Furthermore, two pieces were drawn from the intervention group (units for observational study at T2), and one of these two was drawn (unit for observational study at T3), and repeated for the control group.

Regarding PNKAS-N, all six units were included all three times (T1, T2, and T3). In the observational study, all six units were included at T1, two units from the intervention group and two units from the control group were randomly chosen at T2, and one unit from the intervention group and one unit from the control group were randomly chosen at T3. Regarding the interviews with children, one unit from the intervention group and one unit from the control group were randomly chosen at T1 and T2 (the same units at both measurement points).

The allocation by units into either an intervention group or a control group was blinded to the participants (children and parents) at all measurement points and to the healthcare professionals at T1. Healthcare professionals knew whether they had received educational intervention; therefore, blinding was not possible for T2 and T3.

Changes During the Study

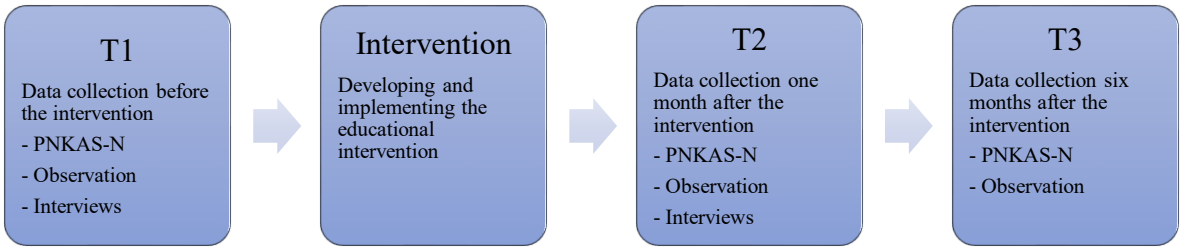
The study plan regarding the observational study was to include all six units at T1 and two units at T2 and T3. However, after T1, we decided to increase the observational study at T2 from two units to four units (randomly chosen). This data collection method was very valuable to measure any changes in the pediatric pain management clinical practice after the intervention (it was possible due to time and expenses), and because of the variety of the clinical practice at the number of included hospitals. After a discussion with the research group, we decided to seek permission from the Regional Committee for Medical Research Ethics (REK) and the hospitals. We received permission and increased the included units from two to four at T2.

4.5 Data Collection

We collected data about nurses' knowledge and attitudes regarding pediatric pain management using a questionnaire (PNKAS-N). For nurses' postoperative pain management

clinical practice, we used nonparticipant observations. To assess how the children experienced pain and pain management after surgery, we used individual face-to-face interviews with the children. Data collection from T1 is presented in Substudies I and II, and data collection from T2 and T3 is presented in Substudy III. The data collection tools used will be explained in more depth. The data collection was conducted from September 2014 to October 2015 (Figure 4).

Figure 4 Study Timeline



4.5.1 Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain–Norwegian Version (PNKAS-N)

The PNKAS-N was chosen to measure nurses' knowledge and attitudes regarding pediatric pain. The original survey, the PNKAS, was developed by Manworren in 1998 (146) and revised in 2002 (147). In 2009, it was translated into Norwegian and tested and validated for Norwegian conditions by Hovde *et al.* (148). The PNKAS was derived from the best practice standards of pain management recommended by the World Health Organization, the Agency for Health Care Policy and Research, and the American Pain Society (146, 147). The items in the questionnaire covered general pediatric pain management, pain assessment, and pharmacological and nonpharmacological pain management. The PNKAS-N comprises 40 items, of which 23 are true or false statements, 13 are multiple choice, and 4 are based on 2 patient cases. Each item in the questionnaire is equivalent to 1 point, with a possible scoring range of 0 to 40. In our study, an additional section was added to the questionnaire to assess nurses' ages, levels of education, work experience and full-time equivalencies, use of pain assessment tools, and whether their hospitals or units had guidelines for pediatric pain assessment and pediatric pain management.

Nurses working with children in the selected units were invited to complete the questionnaire (PNKAS-N). The PhD student distributed a paper version of the PNKAS-N to all the nurses who met the inclusion criteria with an information letter and an envelope for returning the

questionnaires. Participants also received verbal and written information about the study. Written informed consent was obtained from the nurses who completed the questionnaire. The participants received a reminder after two and three weeks, and all questionnaires were collected after four to five weeks. PNKAS-N was collected at all units at all measurement points (Substudy I and III).

4.5.2 Observational Study

The PhD student conducted nonparticipant observations of nurses' pediatric postoperative pain management practices using a structured observational tool (checklist) and field notes. The checklist was developed based on a previous study (121) and current best practice guidelines (149, 150) and included the PNKAS-N themes. The pharmacological pain management given before, during, and after surgery was recorded. In nonparticipant observations, the researcher observes without actively participating in the care (144). The field notes in our study included descriptions of what occurred during the period of nonparticipant observation and the nurses' comments relating to pediatric pain management. The field notes were recorded during observation or directly afterwards, depending on the situation in the unit. No identifying data about the children were recorded in the field notes except for their weight, age, gender, and type of surgery. The other data collected were situational, and care was taken to ensure patient confidentiality. The checklist was piloted on two occasions in another unit (observing three to four hours each day for two days); these data were not included in this study. Following this, the structure of the checklist was adjusted to focus on the child rather than the nurse because some children were cared for by more than one nurse.

The nurses were observed in their clinical practice if they were on duty during the selected observational period. Informed consent was obtained from all persons (nurses, children, and their parents) who were present during the observational study. The observation of the children started from the time they were admitted until the time they were discharged from the PACUs. The PhD student observed the nurses in clinical practice using nonparticipant observations and sat in a corner of the room to avoid disrupting nursing care. During each data collection period, observations were carried out for four to six hours per day (daytime and evening), Monday to Friday, for two weeks per unit. Information overload is common in field research and stretches an individual's ability to record data (151). A researcher's state of mind, level of attention, and conditions in the field affect note-taking; therefore, a daily limit

of one four-to-six-hour observation period was set. Observational study was conducted at all units at T1, four units at T2, and two units at T3 (Substudies I and III).

4.5.3 Interviews with Children

Data regarding children's experiences of pain and pain management in the PACUs were collected using face-to-face interviews with the children. Two different semi-structured interview guides were developed: one for children 6–11 years and one for children 12–18 years. The interview guides were developed based on the work by Polkki *et al*. (131) and the Royal College of Nursing (149), and included questions about what happened when they were in pain, if anyone asked if they were in pain, what helped them when they were in pain, and their suggestions for nurses and other children who were undergoing surgery on how to manage pain. As part of the interview, all children were also asked to rate the worst pain they experienced during their stay at the PACU using either the NRS (152) from 0 ("no pain") to 10 ("worst pain imaginable") or the FPS-R (153) depending on their cognitive capabilities. They were also asked to rate the worst pain experienced during the postoperative period, as well as their current level of pain, using the same scales. In addition, the children's ages, genders, types of surgery, and types of admissions were recorded. The interview guides were piloted in both age groups and conducted in another unit, but the pilot data were not included in this study. A small adjustment was made after the pilot, and an opening question about why the children were at the hospital was added.

Children aged six years and older who had surgery at the time of the data collection period were asked to participate in an interview about their pain experience and pain management in the PACU. Informed consent was obtained from all children and parents, and written informed consent was obtained from all parents and children 12 years and older. Two researchers conducted the face-to-face interviews with one interviewing and one observing. The observer wrote down some field notes containing contextual details. Both the observer and interviewer were specialized nurses (one pediatric nurse and one critical care nurse) who had many years of experience working with children in intensive care units and surgical wards. All the children who were interviewed had been admitted to a PACU for both children and adults. The timeframe for conducting the interviews was three to four days per unit. Each researcher interviewed one to two children per day, for a total of two to four interviews per day.

The children were interviewed in their own rooms or in places where confidentiality could be ensured. The children could choose whether they wanted one of their parents present. The interviewer placed herself close to the child and within line of sight for the possibility of direct eye contact. The parents were politely asked to be quiet during the interviews, but they were given the opportunity to comment at the end. The interviews were audio recorded and started with brief information about the interview situation. The interviewer emphasized that there were no correct or incorrect answers. To help the children talk about and visualize their experiences, the interviewers provided a "toolbox" that included paper and pencil, pain assessment tools, hospital equipment, and a doll. The children were able to describe their experiences by writing and drawing or demonstrating on the doll. The interviews ended with a short debriefing about the interview situation after the tape recorder was stopped. The children were able to choose a small gift of low value as a show of appreciation for their efforts. The interviews were conducted in two units at T1 and T2 (Substudies II and III).

4.6 Data Management

4.6.1 PNKAS-N Analysis

All questionnaires were included and transferred into the Statistical Package for Social Sciences (SPSS). The paper versions of the questionnaires were double-checked with SPSS. Items in the questionnaires that participants had double-ticked were registered as incorrect. All analyses were conducted using SPSS version 22–24 (IBM SPSS Statistics for Windows, version 22–24.0; IBM Corp., Armonk, NY, USA).

In Substudy I, mean and SD were calculated for continuous data that were normally distributed. Frequency counts and percentages were calculated for categorical data. A one-way analysis of variance (ANOVA) was used to determine whether there were statistically significant differences among subgroups that were normally distributed (e.g., educational level, age group, and work experience group) regarding continuous variables (e.g., the total PNKAS-N mean score).

In Substudy III, median and range were calculated for continuous data that were not normally distributed. Frequency counts, percentages, and confidence intervals (CI) were calculated for categorical data. Mann–Whitney *U* tests were used for continuous data to compare the groups concerning variables that were not normally distributed (e.g., age, work experience as a nurse

and work experience in current ward). The overall changes, changes at T2 (short-term), and changes at T3 (long-term), adjusted for T1 (baseline) differences, were estimated using generalized linear mixed models for repeated measures. All tests were two-sided and *p values* < .05 were considered statistically significant. All analysis were considered exploratory so no correction for multiple testing was done. Intention-to-treat (ITT) principles were used when analyzing the data.

4.6.2 Analysis of the Observational Study

The observational data at T1, T2, and T3 were structured using NVivo (NVivo for Windows, version 11–12). Data from the checklist were transferred to SPSS, and double checked against the paper version. All analyses were conducted using SPSS version 22–24. Frequency counts and percentages were calculated for categorical data from the observational data checklist at T1 (Substudy Ⅰ) and frequency counts, percentages, and CIs were calculated for T3 (Substudy Ⅲ). The data from the field notes were not analyzed using content analysis as first planned due to the large amount of data, which included 805 hours of observation and 588 children who had undergone surgery, but were used to attain a deeper understanding of the data obtained from the observational checklist.

4.6.3 Analysis of the Interviews with Children

Children's responses to the interview questions at T1 (Substudy II) and at T2 (Substudy III) were transcribed verbatim by the PhD student using NVivo (NVivo11–12). After the PhD student transcribed the interviews, another researcher checked the transcribed version with the audio recording to ensure the quality of the transcripts. If there was any uncertainty, the third researcher viewed the transcripts. Content analysis was used to analyze the transcripts using a six-step approach by Creswell (144) (Table 4).

Table 4 Data Analysis Process

Data analysis process	
Step 1	Creating and organizing files for data
Step 2	Reading through the text and forming initial codes
Step 3	Coding all the data
Step 4	Describing the social setting, people involved and events
Step 5	Analyzing data to identify emerging themes
Step 6	Interpreting and making sense of the findings

The process of organizing data by bracketing chunks and writing the word representing a category, includes different steps. In the present study, Tesch's eight steps of the coding process were used (144) (Table 5).

Table 5 Coding Process

Coding Process	
Step 1	Get sense of the whole
Step 2	Pick one document and ask "what is this about"
Step 3	Make a list of all topics
Step 4	Abbreviate the topics as codes
Step 5	Make categories
Step 6	Abbreviation for each category and alphabetize
Step 7	Preliminary analysis
Step 8	Recode if necessary

Three researchers analyzed the data at T1 independently and then discussed their themes until consensus was reached. The researchers named the themes a little differently, although the content was similar. After discussion, an agreement was reached about the themes. The PhD student analyzed the data at T2 and discussed it with the members of the research team.

4.7 Validity, Reliability and Trustworthiness

When designing and conducting a study, the researcher should enhance the validity, reliability, and trustworthiness of the study, and reduce or eliminate bias to the extent that this is possible (154). Validity, reliability, and trustworthiness are discussed briefly in the following chapter and further explored in the discussion section.

Validity and reliability are important criteria for measuring variables (154). In quantitative research, validity refers to the degree to which an instrument measures what it intends to measure. There are two types of threats to validity: internal and external threats (144). According to Polit and Beck (2017), internal validity "refers to the degree to which it can be inferred that an experimental intervention, rather than confounding factors, caused the observed effects on the outcomes" (154), and implies that there is no bias in the way the data

is collected, analyzed, and interpreted (155). Various forms of bias can affect internal validity, such as selection bias, confounding, and information bias (155). External validity refers to the generalizability of the study and its sample to other persons, other settings, and other situations and may be affected by sampling bias (154).

In quantitative research, reliability refers to the extent to which scores for participants who have not changed are the same for repeated measurements under several situations, including repetition on different occasions (test–retest), by different participants (interrater reliability), on different versions of the measure (parallel test reliability), or in the form of different items on a multi-item instrument (internal consistency) (ibid.). The reliability tests concerned consistency, absence of variation in the measurement, and reproducibility. In test–retest reliability, a measure is administered to the same participants on two occasions (154). The most widely used correlation coefficient is Pearson's *r*. The correlation coefficient indicates how perfectly variables are related; possible values for the correlation coefficient range from –1.00 to +1.00, with the latter indicating a perfect relationship. The most widely used statistic for evaluating internal consistency is the coefficient alpha, Cronbach's alpha (154). The normal range of values is between .00 and +1.00, with higher values reflecting better internal consistency, and coefficients > .70 are generally considered adequate (146), while coefficients of .80 or higher are considered especially desirable (154).

The rigor of qualitative interviews is directly related to the trustworthiness of a qualitative study. Trustworthiness in qualitative studies refers to the degree of confidence that qualitative researchers have in their data and analyses (154). Lincoln and Guba suggest using four criteria for establishing trustworthiness: credibility, transferability, dependability, and confirmability (156). A fifth criterion, authenticity, was added later (154). Credibility in qualitative research refers to research methods that engender confidence in the truth of the data and the researchers' interpretations. Demonstration of confidence in the truth of the study's findings requires that researchers meet criteria including prolonged engagement, persistent observation, triangulation, peer debriefing, and member checking. Transferability refers to study findings that may be transferred to or applicable in other contexts, and it is important to use thick descriptions (ibid.). Dependability demonstrates that the findings are consistent and amenable to replication, and it is important to use an inquiry audit, for example, an outside expert who accesses the study interviews to question the interview's process or findings (ibid.). Confirmability refers to objectivity, in which the degree of the study neutrality is shaped by the study's participants and not the author's biases or personal

interests (ibid.). It is important to describe the interview research steps taken, and maintaining a reflexive journal with regular entries enables the author to record methodological decisions and the rationale for the decisions. Furthermore, authenticity refers to how fairly and faithfully the researcher shows a range of realities (154).

How we enhanced the validity, reliability, trustworthiness, and reduced chances of bias in the present study will be elaborated on in the Discussion section.

4.8 Ethics

This study was designed and carried out in accordance with ethical principles for medical research involving human subjects, as stated in the World Medical Association's Declaration of Helsinki (157). Approvals were obtained from REK South-East, Norway (ID: 399805), hospitals' local Social Science Data Services (NSD), and hospital unit managers. The study was conducted in accordance with the Health Research Act (158).

In accordance with The Health Research Act (158), all participants in the present study received information about the study, explaining that participation was voluntary and that the information would be treated anonymously. Nurses who were invited to participate in the questionnaire received verbal and written information about the study, and written informed consent was obtained from the participants. Furthermore, informed consent was obtained from all participants (nurses, children, and their parents) for the observational data collection.

The present study involved interviewing children after surgery, and precautions were taken to protect the patients and ensure that the risks and inconveniences would be as few as possible. The nurses on the surgical wards identified children who met the inclusion criteria for interviews, and asked them if they were interested in information about the study. The children and parents who accepted the invitation were given verbal and written information about the study by the researchers, and were then given time to consider whether they wished to participate. Three age-appropriate information letters were used: one for children aged 6–11 years, one for children aged 12–18 years, and one for parents. Informed consent was obtained from all children and parents, and written informed consent was obtained from all parents and children 12 years and older. Ethical considerations are elaborated on in Section 6.3.

5 RESULTS

This chapter summarizes the main results of each substudy.

5.1 Participants and Recruitment

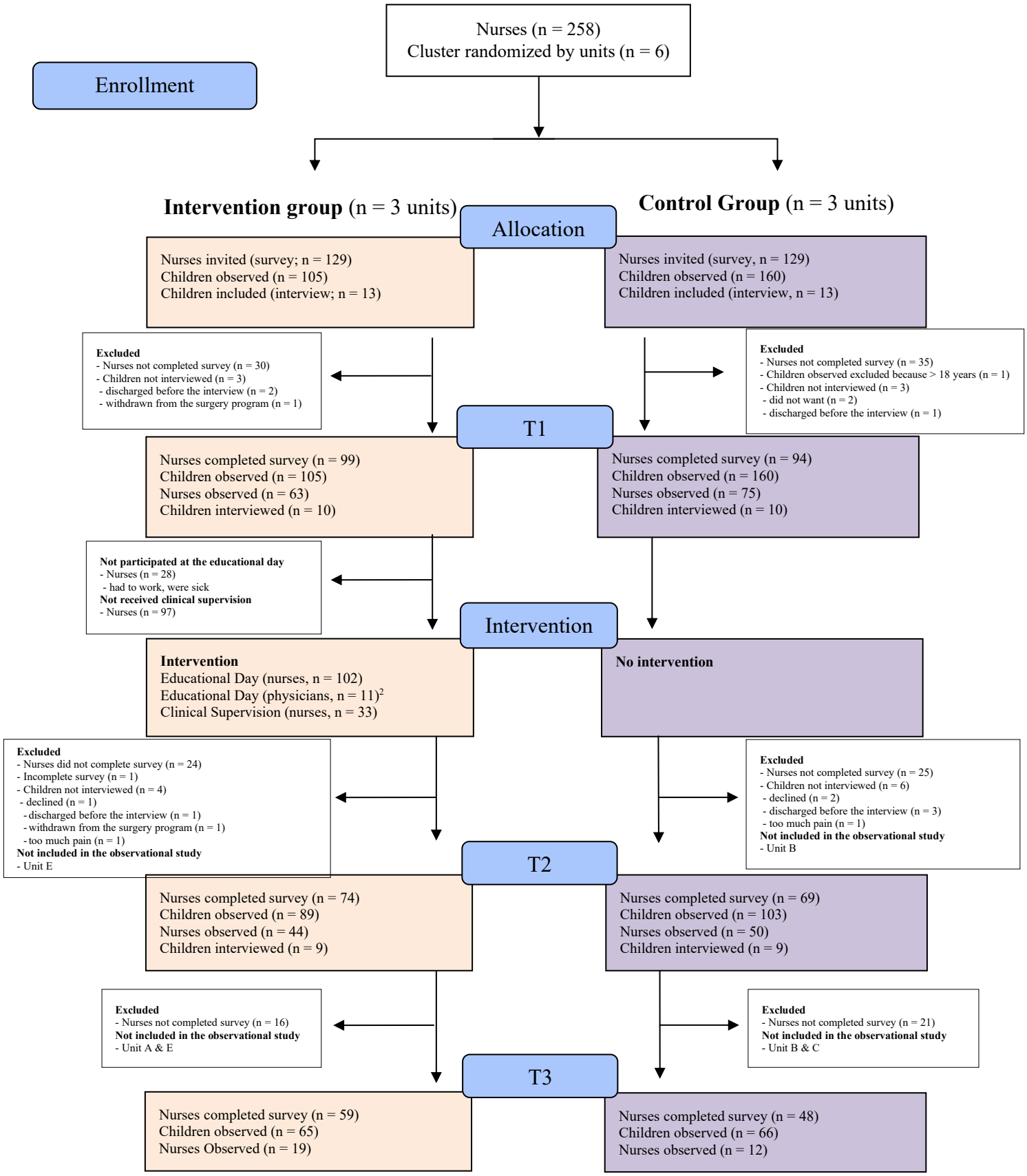
This section describes the recruitment and background characteristics of the participants. The sample for this study consisted of nurses and children. Nurses working in six PACUs were invited to complete the PNKAS-N (Substudy Ⅰ and Ⅲ) and observed providing postoperative pain management care to children (Substudy Ⅰ and Ⅲ). Children older than six years who underwent surgery at the time of the data collection period were invited to participate in interviews (Substudy Ⅱ and Ⅲ).

PNKAS-N

Altogether, 258 nurses from six units were invited to answer the PNKAS-N, 193 nurses completed at T1 (75% response rate), 143 nurses at T2, and 107 at T3. Ninety-five nurses completed the questionnaire at all three times: 60 nurses twice and 38 nurses once. In total, 40 of the nurses did not respond to follow-ups due to having quit the job or having started university to become specialist nurses.

Participant inclusion and allocation are presented in Figure 5.

Figure 5 Flowchart Showing the Participant Inclusion and Allocation[1]



[1] Reprinted from Smeland, A. H., Twycross, A., Lundeberg, S., & Rustøen. (2018). Knowledge, attitudes and clinical practice in pediatric postoperative pain management. Pain Management Nursing: Official Journal of the American Society of Pain Management Nurses, *19*(6), 585–598, Copyright (2023), with permission from Elsevier.

[2] Participated in the entire educational day.

Background Characteristics of the Nurses

The background characteristics of the nurses who completed the PNKAS-N at T1 are described in Table 6. For the total sample, the nurses' median age was 42 years, the median years of work experience as nurses was 16 years, and more than half were critical care nurses. There were statistically significant differences between the intervention groups. The control group included nurses' ages (p = .011) and working years as nurses (p = .005).

Table 6 Background Characteristics of the Nurses Who Completed the PNKAS-N at Baseline

	Total Sample N = 193	**Intervention Group** n = 99	**Control Group** n = 94	***P***
Characteristics	*Median (range)*	*Median (range)*	*Median (range)*	
Age (years) (n = 186)	42 (23–63)	44 (23–63)	40 (24–62)	.011
Work experience in nursing (years) (n = 193)	16 (2–40)	17 (3–40)	14 (2–40)	.005
Work experience in current ward (years) (n = 174)	5 (0–32)	5 (0–32)	5 (0–18)	.111
	n (%)	*n (%)*	*n (%)*	
Educational level (n = 193) Bachelor's Specialist nurse	 66 (34) 127 (66)	 31 (31) 68 (69)	 35 (37) 59 (63)	.448
Nursing specialty (n = 127) Critical care Pediatric Other specialty	 108 (56) 16 (8) 3 (2)	 64 (65) 1 (1) 3 (3)	 44 (47) 15 (16) —	

The nurses responding to the follow-ups had longer work experience as a nurse (p = .008) than the nurses who dropped out during the study, but there were no statistically significant differences in age, work experiences in current ward or educational level between responders and dropouts at T2.

Observational Study

More than half of the nurses (53%) were observed providing postoperative care to 265 children at T1 (68% at T2 and 51% at T3). The total observation time was 805 hours (416 hours at T1, 252 hours at T2, and 137 hours at T3). The PhD student observed four to six nurses each day. The average period of time for which the children were admitted to the PACU was less than two hours (mean, 114 minutes; SD, 63 minutes).

Background Characteristics of Observed Children

Data from observations were collected for two weeks at each PACU and included 265 children at T1 (all units), 192 children at T2 (four units), and 131 children at T3 (two units). Almost half of the children were under five years of age, and the main surgery group was ear/nose/throat surgery (Table 7).

Table 7 Background Characteristics of the Children Observed

	Total Sample (N = 588) n (%)	**Intervention Group** (N = 259) n (%)	**Control Group** (N = 329) n (%)
Age in years			
0–5	265* (45)	115 (45)	149 (45)
6–11	159 (27)	65 (25)	94 (29)
12–18	164 (28)	78 (30)	86 (26)
Surgery Type			
Orthopedic	139 (24)	62 (24)	77 (23)
Ear/Nose/Throat	162 (28)	133 (51)	29 (9)
Gastro	141 (24)	32 (12)	109 (33)
Other**	146 (25)	32 (12)	114 (35)

* *Including seven children under three months of age*
** *Others include plastic surgery, back surgery, neurosurgery, etc.*

Interviews with Children

Altogether, 54 children met the inclusion criteria for interviews. Sixteen were excluded because they were discharged from the hospital before there was time to interview (n = 7), did not want to participate (n = 5), were in too much pain (n = 2), or withdrew from the surgical program (n = 2). Thirty-eight children were interviewed (20 at T1 and 18 at T2). Thirty-four interviews were conducted at the hospital within 48 hours after the child's surgery, and 4 took place between the third and sixth postoperative days. The interviews lasted for 7–25 minutes. Most children (n = 29) chose to have their parents present during the interviews. The interviews took place in their own room or a private room with only the interviewers (and, if they chose, their parents) present to ensure confidentiality and limit interruptions.

Background Characteristics of the Children Interviewed

The interviews with children were conducted at two of the six hospitals and included 20 children at T1 and 18 children at T2. Almost equal numbers were male or female, and the most common type of surgery was orthopedic surgery (Table 8).

Table 8 Background Characteristics of the Children Interviewed

	Total Sample (N = 38) n (%)	**Intervention Group** (N = 19) n (%)	**Control Group** (N = 19) n (%)
Age in years			
8–11	16 (42)	8 (42)	8 (42)
12–18	22 (58)	11 (58)	11 (58)
Gender			
Female	21 (55)	9 (47)	8 (42)
Male	17 (45)	10 (53)	11 (58)
Surgery Type			
Orthopedic	18 (47)	12 (63)	6 (32)
Ear/Nose/Throat	4 (11)	3 (16)	1 (5)
Gastro	8 (21)	4 (21)	4 (21)
Other*	8 (21)	—	8 (42)
Type of Admission			
Elective surgery	19 (50)	10 (53)	9 (47)
Elective day surgery	9 (24)	5 (26)	4 (21)
Emergency surgery	10 (26)	4 (21)	6 (32)

**Others include plastic surgery, and back surgery.*

Tailored Educational Intervention

Altogether, 79% (102 of 129) of the nurses in the intervention group participated at the educational day, and 106 physicians participated for the entire (n = 11) or part of (n = 95) the educational day. The educational day was mandatory for nurses in the intervention group, but because of heavy workloads or sick leave, only 102 nurses participated. Furthermore, 26% (33 of 129) of the nurses received clinical supervision. A total of 83% (82 of 99) of the nurses in the intervention group who completed the questionnaire at T1 participated in the educational day, and 27% (n = 27) of these nurses also received clinical supervision in pediatric pain management. All the nurses in the intervention group who completed PNKAS-N and received clinical supervision also participated in the educational day.

Intervention Evaluation

In total, 23 physicians and 124 nurses completed a written evaluation of the educational day. However, only eight of these physicians were present for the entire educational day. When evaluating the whole educational day, 80% of the physicians and 87% of the nurses reported that they were pleased with the content of the day and that they had gained new knowledge and inspiration. The physicians rated the pharmacological section (86%) and the parallel section for physicians (91%) as the most useful, while the nurses found the pharmacological (96%) and general pain management (93%) sections to be the most useful.

In total, 18 of 33 nurses completed the evaluations for clinical supervision, and 83% reported it as useful overall. The nurses reported receiving clinical supervision in pain management

principles (94%), pain assessment tools (100%), pharmacological principles (89%), and nonpharmacological principles (83%). Nurses reported the supervision of pain assessment tools (89%) and pharmacological principles (81%) as the most useful.

5.2 Main Results of Substudies I–III

In this section, the results from the three substudies are described. To explore pediatric postoperative pain management in PACU, we measured nurses' knowledge, attitudes, and clinical practice regarding pediatric postoperative pain (Substudy I) and explored children's experiences of pain and postoperative pain management (Substudy II). In Substudy III, we evaluated whether a tailored educational intervention would increase nurses' knowledge and attitudes and improve pediatric postoperative pain management in PACUs.

Table 9 Summary of the Main Results in the Three Substudies

Paper	Aim	Main Findings
I	To identify nurses' knowledge, attitudes, and clinical practice regarding pediatric pain management in PACUs and to determine whether there is a link between knowledge and actual practice, using a combination of methodological approaches to obtain new information in this context	The total PNKAS-N mean score was 29 out of 40. Nurses have knowledge deficits, mainly in pharmacological pain management, such as the risk of addiction and respiratory depression. Specialized nurses scored significantly higher than nurses with only a bachelor's degree. Nineteen percent of the children were assessed using a pain assessment tool. More than 66% of the children received an inadequate dose of morphine postoperatively. Discrepancy between nurses' self-reported use and observed use of pain assessment tools. Knowledge gaps in pharmacological management concur with observed practice.
II	To explore children's experiences with pain and postoperative pain management in PACUs. With the overarching goal of influencing future clinical practice, we sought to gain a greater understanding of children's experiences and to gather their recommendations for improving postoperative pain management	Three themes: 1. Children's experiences of what felt unpleasant and painful 2. Children's experiences with pain management 3. Children's recommendations for future pain management The children experienced moderate to severe pain, and pain in places other than the surgical wound. Few were assessed for pain. Pain management was suboptimal. We obtained useful information about their experiences, why they did not say when they were in pain, and how to improve pain management.

III	To assess whether a tailored educational intervention for nurses working in Norwegian PACUs increased their knowledge and attitudes regarding pediatric pain management and improved actual postoperative pain management in an intervention group compared to a control group	No overall statistically significant differences in the change in the total PNKAS-N mean score between the groups when controlling for baseline differences. Knowledge increased in the intervention group. Observed use of pain assessment tools increased in the intervention group, and children reported less moderate to severe pain.

5.2.1 Substudy I

Nurses' Knowledge, Attitudes, and Clinical Practice in Pediatric Postoperative Pain Management

This study was conducted in PACUs at six university hospitals in Norway, using PNKAS-N to measure nurses' knowledge and attitudes, and nonparticipant observational study to measure nurses' clinical practices.

All nurses (n = 258) working in the included PACUs were invited to answer the PNKAS-N, and 193 completed the questionnaire (75% response rate). Observational data were collected for two weeks at each of the six PACUs, and 138 nurses were observed giving postoperative pain management to 265 children who had undergone surgery. More than half of the nurses (53%) working in PACUs were observed during one or more shifts. None of the nurses, parents, or children refused to participate in this observational study.

The total PNKAS-N mean score was 29 out of 40 (range: 14–40). We identified knowledge deficits mainly in pharmacologic management, including knowledge of useful drugs (29% answered correctly), risk of addiction (35%), and respiratory depression (20%). Specialized nurses scored significantly higher (mean score: 29.3 vs. 27.8, $p = .020$) than nurses with only a bachelor's degree. Twenty-two percent of the nurses were observed using pain assessment tools. Pain was assessed using validated tools in 19% of the children (all age), and in 9% of the children under five years of age. More than half of the children (66%) received an inadequate dose of morphine postoperatively (lower than < 0.05mg/kg), and 25% received both paracetamol and NSAIDs. Many nurses (75%) gave the smallest amount of the prescribed opioid dose (morphine or ketobemidone) if it was prescribed on a sliding scale of, for example, 0.05–0.1 mg/kg. Nurses often used nonpharmacological pain management techniques, such as being present (81%), creating a comfortable environment (69%),

providing information (53%), and distraction (47%). However, nurses seldom used nonpharmacological techniques like skin-to-skin, facilitated tucking, swaddling for babies, or distractions like using phones, tablets, watching a movie, or playing with toys in the PACUs.

Nurses have knowledge deficits about pediatric pain management and do not always use their knowledge in practice, particularly in relation to pain assessment. We found a discrepancy between nurses' self-reported use of pain assessment tools and their observed use in clinical practice. Almost all of the nurses (84%) reported using pain assessment tools, but based on the observational data, only 22% of the nurses were observed using pain assessment tools.

Nurses lack knowledge of basic pediatric pain management, especially pharmacological matters. This concurs with observed clinical practice, in which more than half of the children received inadequate doses of morphine.

5.2.2 Substudy II

Children's Views on Postsurgical Pain in Recovery Units in Norway: A Qualitative Study

To explore the children's experience of pain and postoperative pain management in PACUs, this study was conducted with 20 children (8–16 years old) at two university hospitals in Norway using individual face-to-face interviews. Data were analyzed using content analysis, and three themes emerged: children's experiences of what felt unpleasant and painful, children's experiences with pain management and children's recommendations for future pain management.

The children reported moderate to severe pain, and for some children, the pain escalated during the hospital stay. Many children also experienced pain in places other than their surgical wounds (e.g., sore throat, back pain, pain in shoulder/neck/heels/mouth and headache). Children who experienced PONV stated that nausea and vomiting felt unpleasant and painful, while others were afraid that they might experience it. Some children did not tell their nurses when they had pain, and a few were assessed with pain assessment tools.

They provided useful information about their pain experiences and explained why they did not tell their nurses when they were in pain (e.g., they tried to endure it, did not want pain medication, or believed that the nurses could see when they were in pain). The children

indicated that pain medications helped them relieve their pain. Some children described that it was difficult to swallow tablets and unpleasant to receive a rectal suppository. The children reported that the use of nonpharmacological methods helped them cope with their pain and elaborated on which methods were effective and why. The children most often used positioning, relaxation, and distraction to relieve pain, and nurses most often used positioning and heat and cold techniques. To improve pain management, the children suggested that the nurses give them pain medication when needed, provide more preparatory information (e.g., what was going to happen, would it hurt after surgery, not to drink too much because then you have to vomit), and talk to them. The children also suggested that their parents should be present when they awaken in PACU. The children's recommendations for other children having surgery were to distract from the pain (e.g., think of something else, think of something nice, talk to someone), stay calm, try to relax and sleep, and take pain medication.

5.2.3 Substudy III

Educational Intervention to Strengthen Pediatric Postoperative Pain Management: A Cluster Randomized Trial

This study was conducted in PACUs at six university hospitals in Norway using a cluster RCT, measuring at baseline (T1), and one month (T2), and six months (T3) after a tailored educational intervention. Data were collected using PNKAS-N, a nonparticipant observational study of nurses' clinical practices, and interviews with children. Nurses were cluster randomized by unit into a control group or an intervention group.

A total of 258 nurses were invited to participate. At T1, 193 nurses completed the PNKAS-N, 143 completed it at T2, and 107 completed it at T3. Observations of nurses' clinical practices included observing more than 50% of the nurses giving postoperative care to 588 children. In total, 38 children were interviewed (20 children at T1 and 18 children at T2).

This study showed that the nurses' total PNKAS-N mean scores improved after the intervention but also in the control group. After controlling for T1 (baseline) differences, there were no overall statistically significant differences in the change in PNKAS-N mean score between the groups. In the intervention group, between T1 and T2, there was a statistically significant improvement in the total PNKAS-N mean score (27.8; 95% CI [27.0-28.7] vs. 33.0; 95% CI [32.0-34.0]). Between T1 and T2, nurses' self-reported use of pain assessment tools increased, especially the FLACC (6%; 95% CI [1%-11%] vs. 73%; 95% CI

[63%-83%]), and the observational study revealed that nurses increased their use of pain assessment tools (17%; 95% CI [10%-24%] vs. 39%; 95% CI [29%-49%]), especially in children under five years of age (5%; 95% CI [-2%-12%] vs. 36%; 95% CI [22%-51%]). In the control group, between T1 and T2, there was some improvement (not significant) in the total PNKAS-N mean score (30.1; 95% CI [29.2-31.0] vs. 31.7; 95% CI [30.7-32.8]) and nurses' self-reported use of FLACC (46%; 95% CI [36%-56%] vs. 60%; 95% CI [54%-80%]), but there was no improvement in the observed use of pain assessment tools (21%; 95% CI [14%-27%] vs. 20%; 95% CI [12%-28%]).

In the intervention group, between T1 and T3, there was statistically significant increased use of intravenous paracetamol (28%; 95% CI [18%-37%] vs. 73%; 95% CI [61%-85%]), and increased (not significant) use of NSAIDs combined with paracetamol (28%; 95% CI [19%-36%] vs. 43%; 95% CI [31%-55%)) and in administering adequate doses of morphine or ketobemidone (17%; 95% CI [4%-29%] vs. 46%; 95% CI [26%-67%]). In the control group, between T1 and T2, there was a significantly increased use of intravenous paracetamol (32%; 95% CI [23%-41%] vs. 53%; 95% CI [42%-63%]).

Between T1 and T3, a significantly increased use of preparatory information (61%; 95% CI [51%-70%] vs. 82%; 95% CI [72%-91%]) and comforting/reassurance (43%; 95% CI [33%-52%] vs. 71%; 95% CI [59%-82%]) was revealed in the intervention group. Between T1 and T2, there was also an increased (not significant) use of distraction, positioning, and heat and cold. In the control group, between T1 and T3, there was a significantly increased use of distraction (49%; 95% CI [41%-57%] vs. 73%; 95% CI [62%-84%]), and between T1 and T2, there was a significant increase in the use of both preparatory information (44%; 95% CI [36%-52%] vs. 80%; 95% CI [72%-88%]) and heat and cold (16%; 95% CI [10%-22%] vs. 41%; 95% CI [31%-50%]).

Children reported moderate to severe pain, pain in a location other than the surgical wound, and little use of pain assessment tools, and explained why they did not tell when they were in pain. They provided valuable information on what helped them relieve pain and gave recommendations on how the nurses could improve pain management and what other children who were undergoing surgery could do to cope with pain. At T2, the children in the intervention group reported less moderate-to-severe pain and increased use of pain assessment tools. Further, they experienced that pain medication helped and elaborated on which non-pharmacological pain-relieving techniques helped them cope with pain.

6 DISCUSSION

In the first part of this chapter, methodological considerations will be discussed, followed by discussions of the main findings, ethical considerations, and a summary of the strengths and weaknesses of the study.

6.1 Methodological Considerations

Several important methodological considerations apply to this study. In the following sections, the methodological discussion is framed by the CONSORT 2010 guideline for reporting cluster trials (75), risk of bias assessment in randomized trials (159) and frameworks of quality criteria by Lincoln and Guba (154).

6.1.1 Study Design and Sample

The present study had a cluster randomized design using different methodological approaches. The participants in the study were randomized by unit into an intervention or a control group. An two-armed RCT is a trial design in which the study sample is divided randomly into an intervention group and a control group to mitigate the chances of self-selection by participants or bias by the study designers (selection bias) (154). If the RCT is large enough it is likely that differences between the groups are small, e.g., the randomization ensures that the groups are comparable and the problem of confounding is avoided because the intervention group and the control group are similar in all respects, e.g., the distribution of background variables is similar in both groups. In the present study, we cluster randomized by unit, but because there were few available units, it was possible to include only six. We chose cluster randomization by unit because educational intervention is more suitable to deliver to groups (e.g., hospital units) and to avoid contamination (e.g., nurses working in the same unit) (160), because participants may communicate with each other if they work in the same unit and thus influence the outcome (144). However, cluster randomized trials are often more prone to selection bias, and tend to involve small samples with differences within and between groups (161), which were also found in the present study. Randomization works but only when the groups are quite large, especially when the sample is from a heterogeneous population. At baseline in the present study, there were statistically significant differences between the intervention and control groups concerning age and work experiences as a nurse. When such differences arise and may cause confounding, variables which are not similarly

distributed in the two groups should be adjusted for in a statistical model. In our case, these differences were adjusted for in the generalized linear mixed models for repeated measures.

In recent decades, there have been shifting approaches in complex research from the RCT approach to the pluralistic approach (162). It has been argued that healthcare systems are not suited to linear interventions solved with RCT because healthcare is a dynamic process that entails unpredictability (162). Changing healthcare is difficult because it is a complex, adaptive system (145). Managing change in healthcare requires an understanding of complexity because healthcare performance and behavior change over time, occur in various combinations of care, and are unpredictable and non-linear (163).

Triangulating Data

In the present study, we used multiple triangulations to obtain a broader view of pediatric postoperative pain management. Triangulation in research involves the use of different sources of information by examining evidence (144, 154). The purpose of the triangulation mixed methods design is to collect both quantitative and qualitative data simultaneously, and use the results to understand a research problem (144). There are four types of triangulation (data, investigator, theory, and methodological triangulation) (164). We used methodological triangulation by using multiple methods of data collection and combining qualitative and quantitative data collection techniques (e.g., questionnaire, observations, interviews), data triangulation by collecting multiple times (three times), on multiple sites (six units), and from different samples (children and nurses), and investigator triangulation by using more researchers when conducting, coding, analyzing, and interpreting the interviews with children.

Multiphase projects, such as the development and assessment of an intervention, are suitable for using mixed methods, because the findings from one approach can be greatly enhanced with a second source (154). Triangulation can enrich research, help explore the phenomenon, help explain the results (164), and increase the validity, strength, and interpretative potential of a study (165).

Pain is a biopsychosocial complex phenomenon that needs to be assessed from a broad perspective (22). Pediatric pain management involves healthcare professionals, children, and their parents, and healthcare is a complex adaptive system (145). Therefore, we found triangulation suitable for this study.

In triangulation, there are three possible outcomes: convergent, complementary, and divergent or contradictory (166). The researcher should not expect identical findings but should anticipate a wider, more complex picture to emerge than if only a single method was used (167). Combining both quantitative and qualitative data in a single study using multiple sources enhances the validity of a study's conclusions (154). Thus, in our study, we used both qualitative and quantitative strategies to enhance the complementary findings and strengthen the research (165). However, using multiple triangulation was time-consuming, expensive, demanding, and required skills in both quantitative and qualitative techniques, as known from literature (166).

Sample

Sampling bias refers to external validity, in which the sample is not representative of the population from which it was drawn, and may result in over- or underrepresentation of some segment of the population (154). To reduce sampling bias in the present study, we included all nurses working in PACUs in all six university hospitals in Norway. However, no PACUs from local hospitals were included due to the small number of children undergoing surgery at the local hospitals. Because this study was not conducted in local hospitals, the sample may not be representative of them. However, the six included PACUs cover all health regions in Norway, and the university hospitals have local, regional, and national functions. Nurses in the present study cared for children of all ages from all parts of Norway who underwent various surgical procedures. Furthermore, five of the included PACUs cared for both children and adults, which is similar to local hospital settings.

Although pain management is multidisciplinary (7), the present study focused mainly on nurses. It is important that nurses and physicians have updated knowledge of pain management because they should work together to relieve children's pain after surgery. However, nurses are present caring for the children in the PACU and play a major role in pain management the first hours after surgery; therefore, this study provides, for the first time, insight into how nurses manage children's postoperative pain in PACUs in Norway, as well as their knowledge regarding pediatric pain management, and children's experiences regarding postoperative pain management they received in the PACUs.

The nurses' ages, educational levels, and work experience in nursing (years) may be comparable to those of nurses working in PACUs in local hospitals. However, nurses working

in PACUs in local hospitals seldom care for children who have undergone surgery, and there are reasons to believe they are less trained and may have less clinical competence in pediatric postoperative pain management compared to this trial's participants. This indicates that our findings related to nurses' competencies in pediatric postoperative pain at T1 may be overestimated compared to nurses working in local hospitals.

The children recruited for interviews were from two hospitals. The children interviewed were 8–18 years old and underwent a range of surgical procedures. Exploring the breadth of pain experiences provides valuable information about children's experiences across these contexts. Maximum variation is widely used and invites enrichments (154). Furthermore, to reduce selection bias, the nurses working in the surgical wards identified the children who met the inclusion criteria and asked them if they wanted information about the project. Thereafter, if the children agreed to receive information, the researcher informed them about the study.

Selection bias resulting from preexisting differences between groups affects the internal validity of the study (154). To reduce selection bias, we randomized the participants to the intervention or control groups (159).

6.1.2 Intervention Feasibility

In the present study, we used different implementation frameworks to serve different purposes (e.g., to identify determinants and to report). To identify determinants of implementation, we used the CFIR because it provides a pragmatic structure for in approaching complex, interactive, and multi-level tailored interventions (70). CFIR has been used in many other studies, and a systematic review by Kirk and colleagues, published in 2016, concluded that more in-depth use of CFIR may help advance implementation science (168). Using CFIR as a framework, we aimed to predict the barriers and facilitators to implementation effectiveness, and to guide the choice of tailored KT strategies we used.

There are many implementation frameworks, and combining two multi-level frameworks like the CFIR and Theoretical Domains Framework with different purposes (e.g., implementation determinants vs. intervention development) might more fully define the multilevel nature of implementation (68). Using multiple frameworks might help researchers address complex intervention studies; however, it might also result in unnecessary complexity and redundancy if doing so does not address the study's needs (68). However, it could have been beneficial to

our study to combine the use of CFIR with the Expert Recommendations for Implementing Change compilation to support choosing implementation strategies to address contextual barriers (169).

Our first two KT goals were to generate awareness and interest and to share knowledge about pediatric postoperative pain management (Table 3). To achieve this, the participants needed to participate in the study, and participate in the educational day. Further, to evaluate whether the KT goals were reached, we used different measurements, such as reach and usefulness indicators described by Barwick (170, 171). The educational day was offered only as a one-day seminar, despite evidence that repeated interventions are needed to achieve KT in clinical practice (66). This was due to time and cost issues, but to strengthen the present study, we implemented reminders. The reminders were in different forms (posters, newsletters, and focus weeks) and posted in different places to reach the staff (as elaborated in 4.3). Every unit had its own implementation team (unit leader, physician, and educator), which had the essential function of keeping the implementation process focused and solving problems that may arise (172). However, our teams were small and vulnerable and should preferably be larger and more robust.

The educational day was mandatory for the nurses (and counted for in the shifts) and voluntary for the physicians. However, not all nurses (79%) participated in the educational day. The reasons for not participating were that nurses were on sick leave or had to work because of heavy workloads, which have been identified as a barrier to effective pain management in previous studies (173-175). Furthermore, only 26% of the nurses received clinical supervision. The reason for this was that clinical supervision was offered only three to six days per unit due to time and cost constraints.

To evaluate the intervention's usefulness, we asked the participants to evaluate the educational day and clinical supervision. The evaluation of the educational day revealed that most of the nurses (87%) and physicians (80%) were pleased with the content of the day and that they had gained new knowledge. Furthermore, nurses who received clinical supervision reported it as useful overall (83%), especially in terms of pain assessment tools (89%).

In the present study, we revealed a knowing–doing gap, which is a known challenge (176, 177). One KT goal in our study was to facilitate practice and behavior change in improving pain management clinical practice based on the baseline findings. To achieve this, we used different KT strategies and an implementation plan (Table 3). Bridging the knowing–doing

gap is mentioned as one of the most important challenges for public health in this century (177). Strategies to close the gap between research and practice have been identified to maximize the benefits of research through improved health outcomes, better health services and products, and more effective health service delivery (177). To enhance the KT into clinical practice, we used KT strategies tailored to meet local needs, including tailored educational intervention, educational materials, clinical supervision, audit, feedback, implementation team, and reminders. These strategies targeted different barriers to effective pain management identified at T1, which has been shown to be effective in other studies (178, 179). A systematic review done by Gagnon *et al.* (67) identified that examinations of patient-related outcomes and the long-term impact of pediatric pain KT programs were limited. In our study, we included knowledge users by interviewing children, which provided valuable information on how they experienced pediatric pain management. However, to strengthen the intervention and improve the outcome, we should have included them actively during the intervention.

We identified the determinants of implementation at each unit at T1. We found barriers at the individual level—nurse-related, patient-related, and physician-related—and at the organizational level. The key to improving clinical practice is to identify barriers and facilitators (115, 180). Organizational contextual features are important determinants for implementing EBP across healthcare settings (181). KT strategies that bridge the gap can be effective in promoting healthcare professionals' use of clinical research evidence to enhance clinical practice and improve clinical outcomes (66). In the present study, the KT strategies were tailored to the unit context, we had support from unit leaders, the staff was engaged, and there was dedicated time and resources, which has been identified as facilitating the effective implementation of the strategies (66, 182). The present study had a complex intervention, which was multilevel and multifaceted to match the barriers; however, it was expensive and difficult to conduct.

6.1.3 Data Collection

PNKAS-N

Information bias refers to bias arising from measurement errors (183). In the present study, the PNKAS-N was chosen to measure nurses' knowledge and attitudes regarding pediatric pain. PNKAS was selected for use in this study after a thorough review of the literature on

nurses' knowledge and attitudes toward pain and pain management in the pediatric population. These items were designed to assess both knowledge and attitudes regarding pediatric pain assessment, and management, including pharmacological and nonpharmacological interventions. The PNKAS has been used in many studies (12-15, 76-81, 83-85, 87, 88, 94, 95, 99) and was found suitable for use in our study.

The present study may have a random and systematic information bias. The PNKAS-N comprises 40 items, of which 23 are true or false statements, 13 are multiple choices, and four are based on 2 patient cases. Random errors might have occurred because the questionnaire had 23 true and false questions, and if the nurses did not know the correct answers, they might have guessed. Systematic errors might have occurred because the PNKAS, which was developed in 1998 and revised in 2002, had key answers based on the standards of pain management for that period, and these standards might since have changed. For example, the question about opioid addiction may no longer be valid (184). The original answer stated that there was less than a 1% risk of opioid addiction for patients treated for pain, which might be too low (184). Therefore, Manworren (published a letter to the editor) recommended that responses of less than 1% and 5% should be categorized as correct (184). Adjusting for this recommendation in our study, this question would no longer be among the bottom 10 correctly answered questions (Substudy I), but the total mean score would remain the same. In our study the original answer of 1% risk was used.

Furthermore, the PNKAS-N asks nurses to explain what they would do in hypothetical cases. The answers might not necessarily reflect their actual practices. Another challenge in the present study was social desirability; in self-reports, participants will often report inaccurately on sensitive topics in order to present themselves in the best possible light (185). This phenomenon could be true, as the nurses might know the correct answer even if they do not perform like this in their clinical practice. However, by also observing the nurses' clinical practice, we revealed how they actually managed the children's pain.

Selective Loss to Follow-Up

The present study had a response rate of 75% at T1. The level of knowledge among non-respondents was unknown, but due to background information, the educational level was not significantly different from that of the respondents. Nonresponse is not random, and a low response rate can introduce bias (154). A typical response rate for mailed questionnaires is less than 50% (154), and therefore, we chose to distribute a paper version of the

questionnaire, although it was more time-consuming. Further, to enhance the response rate, the questionnaire was personally distributed together with written and oral information to inform and motivate the participants. After two and three weeks, they received a gentle reminder. However, this was time-consuming.

At T2, 143 out of 193 nurses completed the questionnaire, and 107 out of 193 completed it at T3. Attrition bias refers to participant dropout during the study and incomplete outcome data, and is rarely random (154). To reduce attrition bias, assessments should be made for each outcome, and descriptions of the completeness of outcome data should be reported for the main outcome (159). In our study, the nurses who responded to follow-ups had longer work experiences as nurses, but no difference in age and work experience in the ward or educational levels between nurses who responded to the follow-ups and those who dropped out during the study. Fifty percent of the nurses did not respond to follow-ups because they were not working there anymore. The reasons are unknown for the rest of the nurses who dropped out.

Reporting the sample size calculation in cluster randomized trials is important to show that the trial was sufficiently powered (e.g., had enough participants) to address the research questions adequately without wasting resources or exposing too many participants (186). Thus, a study has to have enough participants so that a predefined between group difference can be shown as statistically significant. Given a statistical power of 80% (beta=0.2) and a significance level of 0 .05 (two-sided testing), 128 participants (64 in each group) were required. Taking into consideration at least a 25% attrition rate at T2 and an additional 10% due to cluster randomization, all nurses working with children in the six selected units (n = 259) were invited to participate to ensure a sufficient number of participants. A difference of two points with SD of four using the PNKAS-N mean score was considered clinically relevant and the study was powered to show such a difference (or larger) as statistically significant. In the present study, the differences in PNKAS-N mean score between groups were more than two points. However, there was higher heterogeneity in the sample than anticipated; thus the variation (SD) was larger than anticipated and therefore, we would have needed a larger sample size to reveal the clinically relevant difference of two points as statistically significant.

Observational Study

In the present study, nonparticipant observations using a structured checklist and field notes were chosen to measure nurses' pediatric pain management practice. The checklist was based on a previous study (121) and best practice guidelines (149, 150), and it included the same themes as PNKAS; thus, it was found useful for this study.

Observation studies are used when one wishes to explore what is happening in a situation and can provide more direct documentation of interaction processes and socio-cultural framework conditions (187). They can be conducted with different levels of participation and interaction (and may be different levels of active or passive, visible, or hidden), and this will often vary throughout the study (188). The method used depends on what one wants to investigate and needs to adapt to the situation. It is not the case that the material becomes better and richer if it happens in secrecy, and it is also incompatible with ethical research principles (187). Nor is it that the more natural it is, the better it is. On the other hand, it is important that those participating in the research are well-informed about what is going to happen, and that the researcher take them seriously and show them respect. In our study, we used nonparticipant observations. The researcher was present in the PACUs, sitting in a corner and not participating in the care. The observer documented the observations in a structured and systematic manner with a checklist during the observation period. This approach is useful to register what the observer actually sees the participants do and to register the incidence of predefined categories by using a prefixed coding system or checklist (188). In the present study, the predefined categories in the checklist included nurses' pediatric postoperative pain management clinical practices (e.g., pain assessment, nonpharmacological, and pharmacological pain management).

The participant's awareness of the observer's presence is one source of bias, and the Hawthorne effect may occur when the participants behave differently because they are being watched (154). To reduce this chance, the researcher could use hidden observations. In the present study, this was not possible; however, the PACUs were often very busy, and the nurses were more occupied and seemed to be less aware of the observer.

Observation studies affect both observers and those observed, regardless of the method (189). A description of an event may have many different versions depending on the researcher's position relative to the event. The researcher will notice different things depending on

whether she is positioned “outside” or “from within.” If a researcher observes from the “outside,” she might gain an overall overview of interaction but might also misunderstand the situation (187). In the present study, more than half of the nurses included were observed at each measurement point, and none of the observed participants withdrew from the study (all agreed to participate). Observation of nurses’ pain management practices was for a limited period, sometimes in very busy units, and it is possible that not all details were recorded. Further, it is difficult to know the justifications of nurses for their actions in pain management because the present study used a nonparticipant approach to observation. However, some nurses discussed pain management issues with colleagues, and some of these discussions were heard by the researcher during the observations.

To reduce information bias, the PhD student used a pretested checklist, was trained and prepared for observations, and did all the observations at all measurement points (T1, T2, and T3) (154).

Interviews with Children

In the present study, 38 children were interviewed about how they experienced pain and pain management. Interviewing children and adolescents is extra challenging and requires that those who are interviewing are extra conscious that there is a skewed balance of power between the interviewer and the child (190). The interviewer must adapt to the child’s age and maturity. One must be extra careful with leading questions, and have in mind that young children think concretely so that words and expressions can easily be misunderstood (words may have double meaning) (62, 190). The interviewer must work to establish contact and gain trust with the child, be willing to follow the child in the narrative, and be more responsive to what the child is telling, ask wondering questions, and follow-up questions. Young children may have difficulty expressing themselves and explaining how they experience pain. It is important that the interviewer does not put words in the mouth of the child but gives the child time to find words that describe their experiences. Therefore, in our study, we included children six years and older, and in order to help children express what they experienced, visualization was used where some of the youngest children drew the situation, showed on their teddy bear, showed how much pain they had on a pain assessment tool (age-adjusted), etc. Further, the child was asked to talk concretely about awakening and to concretize and visualize it: how many people there were, what colors there were on the walls, etc. Then the child could more easily recall what it looked like in the PACU, how they experienced the

pain, what happened, what they found helpful to relieve pain, if they had any recommendations for other children who were having surgery.

The interviewers were handpicked and had extensive clinical experience working with pain management in hospitalized children. They had been trained in interviewing techniques, had pilot-tested the interview guides before the study started, and were aware of the questions that could be used, and which should not be used, for children of different age and/or developmental levels. When they conducted the interviews, they had a toolbox that could be used in different situations in relation to the child's needs (paper and pencil, various pain assessment tools, toys, children's books about being admitted to hospitals, hospital equipment).

The children were interviewed in a hospital in an unfamiliar setting, and did not know the interviewers from before. However, both interviewers used a variety of strategies to establish contact and gain the children's trust before starting the interview. When interviewing children, the interviewer needs to have enough time, as the child must be allowed to move in and out of the themes, take breaks when needed, and play and follow the conversation where the child wants to go (131, 135, 191). The interviewer in the present study assured the children that they could stop or take a break at any time during the interview. The children could also choose to have their parents present during the interviews. Because the interviews were undertaken while the children were still in the hospital, the children may have provided favorable answers. This may result in a positive response bias (144), especially if there is a perception that their answers might affect their care. However, the interviewers were not part of the nursing team, and to reduce the positive response bias, they reassured the children before the interviews that there were no right or wrong answers and assured them that the care they received would not be influenced by whether or not they took part in the study.

To reduce information bias, the same two interviewers were present during all interviews, with one interviewing and one observing. At the end of the interviews, the observer asked questions if something had been forgotten or was unclear, increasing the likelihood that all themes were addressed. Because two researchers were present during the interviews, the observer also had the opportunity to ask the children again and clarify any uncertainty. The child then had the opportunity to explain, confirm, or describe in more depth, or possibly to correct. Importantly, this study provides useful insight into children's views about their pain

management experiences in the recovery unit and identifies areas for further research and ways in which clinical practice can be improved.

To reduce information bias, a semi-structured interview guide was used, a pilot study was conducted, and the researchers (interviewers) were trained and prepared to conduct all the interviews at both T1 and T2.

In the present study, the participants (children and parents) were blinded at all measurement points to reduce performance bias. Performance bias refers to systematic differences in the care provided to participants in a different group than the intervention group (154). Although blinding of participants and personnel is critical in reducing performance bias (159), this was not possible for healthcare professionals at T2 and T3 in this trial because they knew whether they had received educational intervention.

6.1.4 Data Management

Researcher's Position

As a researcher, I entered this field with a pre-understanding of pediatric postoperative pain management. The researcher's perspective and position are of great importance to what kind of knowledge emerges in the research (187). The researcher's own understanding in terms of experience, hypotheses, values, attitudes, academic perspective, and theoretical basis will influence the research (144). What perception the researcher has and what is subliminal or focal (in the background or in the foreground) will also affect the research. Therefore, it is important that the researcher be aware of and reflect on it (187).

As a mother, I have experienced my children being sick, having heart failure, and a leg fracture, and they have been through many painful procedures. As a pediatric nurse, I have been working with children undergoing surgery for two decades. In my master's thesis, I conducted a PNKAS-N survey in children's surgical wards at university hospitals in Norway. I have experienced that there were knowledge gaps among nurses in these included surgical wards. Both my personal experience, and professional experience working with pediatric postoperative pain have influenced my preunderstanding.

In observation studies, one must define what one wishes to observe, be open and exploring, and assess the impact of self-presence (189). One cannot observe all that happens, and it is

important to narrow one's focus, or information overload may occur (189). By conducting fieldwork in our own culture, as in this study, one will have field knowledge, and it may be easier to understand different phenomena (187). On the other hand, there may be some things that one takes for granted. This may lead to field blindness, and the researcher may only see what is known from before and what confirms her own experiences and understanding. However, the researcher who studies a field that is unknown, where she does not know the culture and the "tribal language," can be more open and receptive to knowledge, but at risk of misunderstandings and misinterpretations (187). In the present study, I studied a known field but not in my own organization.

When interviewing children, it is important to gain and maintain a high level of trust (154, 189, 192). The researcher should try to minimize stress, create a relaxed atmosphere, reduce environmental distraction, and strive in a quiet setting without disruption (154). Young children have a lower level of concentration and shorter attention spans compared to adolescents and adults. They can easily be distracted, and one often needs to follow the child and pick up themes when suitable (192). The researchers need to be aware and reflect on their own behavior and how it can affect the children and the data they obtain during the interviews (154, 190). In our study, the researchers who undertook the interviews had many years of experience working with children, which helped them gain trust and connect with the children.

Several factors that I am not aware of could have affected the data generation and analysis. Probably, some of my preunderstandings are inaccessible to me. Consulting with my interdisciplinary research team, some of whom had and some of whom did not have a pediatric background, enhanced the interpretative rigor of the analysis. They provided helpful insights into the research process. Overall, I think my personal and professional experience may have helped me to explore pediatric postoperative pain management in a more informed way.

Analysis

Intention-to-Treat (ITT)

We used ITT analysis when analyzing the data. ITT included all randomized participants in the groups to which they were randomly assigned regardless of compliance with the entry criteria, regardless of the treatment they received, and regardless of subsequent withdrawal

from treatment or deviation from the protocol. ITT analysis has become the "gold standard" for analyzing the results of clinical studies (154, 193) and is generally favored because it avoids bias associated with the non-random loss of participants (159). Performing an ideal ITT requires a complete set of data in which all participants providing data are followed, regardless of any protocol failure (154). It is common for some participants not to complete a study—they may drop out or be withdrawn from active treatment—and are therefore not considered at the end. The number of participants in each group was an important element of the analysis. A generally recommended way to deal with such issues is to analyze all participants according to their original group assignment, regardless of what happened later. By using ITT, the goal is to prevent selection bias. When using a per-protocol approach (PP), only participants in the intervention group that actually attended the intervention, e.g., participated as intended, are analyzed. Such analytical approach is problematic because the intervention and control groups are no longer comparable, the randomization is broken, and it is likely that the possible between group differences are confounded by other variables. There might be some other variables which are differently distributed in those who chose to attend the intervention as attended compared to those who were randomized to the intervention but did not attend. Thus, we do not compare the intervention and control groups anymore but the intervention in combination with known and unknown confounders and the control group. By using ITT, we may minimize the type 1 error (false positive). However, it may result in underestimation of the effects of the intervention if few received the intervention but may reflect more what will happen in real life (154).

Regardless of whether one uses the term ITT, one should decide which and how many participants are included in each analysis (159). In the present study, we used flow charts that indicated the number of analyzed participants and included the number of participants per group for all analyses.

Observations of Clinical Practice

The observational checklist was pretested, and the observer underwent training and preparation to minimize biases. Data from the checklist were transferred to SPSS, and double checked with the paper version to reduce any chance for error when plotting the data (154). When controlling the dataset, we discovered that one child included in the dataset was too old to take part in the study at T1 (18 years old); this observation was drawn from the dataset. Therefore, the total number of children at T1 was 265.

When analyzing the observational data, frequency counts, percentages, and CIs were calculated for categorical data from the checklist. The data from the field notes were not analyzed using content analysis as first planned due to the large amount of data (including 805 hours of observation and 588 children undergoing surgery). Furthermore, using the quantitative data from the checklist was found to be more suitable for measuring effects after the intervention (188). However, field notes were used to reveal a deeper understanding of the data from the observational checklist.

The results from the T1 were addressed in the intervention, and on the educational day, each unit received its own results in the lectures. Because observations were a snapshot of the situation in the unit (observed for two weeks, including half of the nurses and about 70 hours in each unit at each measurement point), it was valuable to check with the participants if the observations confirmed how they experienced their clinical practice in the units (144). During the educational day, the participants got the chance to give feedback on the research results, discuss them in the workshops, and reflect upon the results. Feedback from the physicians during the education day was that they were surprised regarding the low doses of opioids and the great variation within the same unit; however, the nurses confirmed that this was what they experienced on a weekly basis, which supports the findings of the present study.

Interviews with Children

To enhance qualitative credibility, eight primary strategies should be used (triangulate, member checking, rich, thick description, clarify the bias, present negative or discrepant information, spend prolonged time in the field, use peer debriefing, and external auditor to review) (144). In the present study, we used different strategies to enhance qualitative credibility (such as investigator triangulation, member checking during the interview, rich description, presenting both positive and negative findings and descriptive information, and external review).

Three researchers did the transcription, checked the transcriptions, and analyzed and discussed the results. One researcher checked the transcribed version with the audio recording to ensure the quality of the transcriptions. This was valuable because some of the children had a different dialect than the researcher, and therefore sometimes one of the researchers misunderstood the child.

To enhance dependability, researchers should document as many steps as possible and use a detailed case study protocol and database that others can follow (144). In our study, we used several qualitative reliability procedures (check transcripts, comparing data with the codes, meeting, and sharing the analysis with the research team, and cross-checking codes), documented as many steps as possible, and discussed the findings with the research team and one external expert.

We tried to give detailed and rich descriptions to enhance transferability. Readers may disagree or have other perspectives, but it is possible to understand our views. Authenticity refers to how fairly and faithfully the researcher shows a range of realities (154). We enhanced the authenticity through quotes from the children and by describing how the findings were discussed. Because the interviews were in Norwegian and we interviewed children from 8–18 years, and we published the results in English, we had an external expert (interviewing children, knowledge in Norwegian and English languages) who checked the translated quoted to the original.

Reporting Bias

Reporting guidelines are developed to aid in standardized and transparent reporting and to provide the reader with enough information to critically appraise the design, conduct, and analysis of the research (186). To minimize the risk of reporting bias (159) we registered our study in ClinialTrials.gov with the protocol and description of the study, and used the CONSORT 2010 (75) (Substudy III), the TIDieR checklist (73) (Substudy III), the GREET checklist (72) (Substudy III) and Consolidated Criteria for Reporting Qualitative Research (COREQ) 32-item checklist (194) (Substudy II and III).

6.2 Discussion of Main Findings

The overall aim of this thesis was to gain a broader insight into postoperative pain management in children in Norwegian PACUs, and to determine the feasibility and effects of a tailored educational intervention.

We identified knowledge gaps regarding pediatric pain management (Substudy I), some of the children experienced moderate to severe pain after surgery (Substudy II), few children were assessed with a valid pain assessment tool (Substudies I and II) and children received inadequate pharmacological pain management (e.g., lack of multimodal analgesics,

inadequate doses of opioid, and inappropriate administration of analgesics) (Substudies I and II). However, nonpharmacological pain-relieving techniques were often used (Substudies I and II), and children experienced it as helpful (Substudies II and III). By combining the measurements, we gained a better and wider understanding of pediatric postoperative pain management in PACUs. Some results completed each other, but some were divergent and even contradictory (Substudies I and III). Importantly, the children gave valuable recommendations on how to improve pain management (Substudy II).

Altogether, 79% of the nurses participated in the educational day, and 25% received clinical supervision. Furthermore, 11 physicians participated in the entire educational day, and 95 took part in the educational day. During this study, more than half of the nurses completed the questionnaires all three times, and more than half were observed in clinical practice in the selected units. Altogether, the observations included 805 hours and 588 children receiving postoperative pain management in PACUs. After the intervention, when controlling for baseline differences (e.g., age and work experiences as a nurse), there were no overall significant differences in the change in total PNKAS mean score in the intervention group compared to the control group. In the intervention group, there were positive changes in nurses' knowledge regarding pain management and the use of pain assessment tools (Substudy Ⅲ). Furthermore, increased use of NSAIDs, opioids, and adequate doses of opioids was revealed in the intervention group, but this proved not to be statistically significant. However, there was a significantly increased use of paracetamol given intravenously between T1 and T2 in the intervention group.

6.2.1 Pediatric Postoperative Pain Management in PACUs in Norway

The total PNKAS-N mean score at T1 in the present study was lower than a few other PNKAS studies (12, 14, 79, 94, 99), but slightly higher than most previous studies (13, 15, 76, 78, 80, 81, 83-88, 95-98, 148), however, it did not reach an acceptable level of knowledge (84).The present study revealed PACU nurses' knowledge gaps in essential areas, especially regarding pharmacological management. These knowledge gaps concur with the other more recent studies using PNKAS, such as useful drugs for treatment of pain in children (83), risk of addiction (83, 85-87, 96) and respiratory depressions (83, 86, 96). Healthcare professionals' knowledge is essential in pediatric pain management. Nurses and specialized nurses must have evidence-based knowledge (57-59), and as IASP has stated (7), all

healthcare professionals should have this knowledge about pain after surgery. Although there has been a focus on improving pediatric pain management over two decades (24), these studies show that no improvement during this period has occurred.

Results from our study revealed suboptimal pediatric postoperative pain management in many areas (e.g., children experience moderate to severe pain, few use pain assessment tools, little use of multimodal analgesics approach, and inadequate doses of opioids). Nurses and specialized nurses have an important role in postoperative pain management in PACUs and need skills in preventing, controlling, and reducing pain (58, 59). Pain is a personal experience (22) and assessment of children's pain should include use of valid age-appropriate assessment tools and be used systematically (3, 31). However, in the present study, children reported moderate to severe pain, pain in places other than the surgical wound, and little use of pain assessment tools. The results from the observational study confirm this, where nurses were observed using pain assessment tools with only 19% of the children at T1. By contrast, 84% of the nurses reported the use of pain assessment tools (assessed by PNKAS-N); however, few nurses "believed in the child" when the child reported the pain score (assessed by PNKAS-N in hypothetical case-related questions). Other studies reported a low prevalence of documented pain assessment (14, 106, 107, 111, 114, 117, 118) and children reported no use of pain assessment tools (129). The importance of respecting a person's report of pain has been specified in one of the six key points and expanded upon by the addition of the revised pain definition (22). The reasons for the low use of tools in the present study might be due to a lack of pain assessment tools available, lack of knowledge and training in age-specific pain assessment tools, and how to communicate with children about pain.

Multimodal analgesia acts synergistically, with fewer side effects than a single analgesic, and should be used in postoperative pain management (52). However, in our study, only 25% of the children received both paracetamol and NSAID at T1. Furthermore, few received an intravenous opioid postoperatively, and most of those who received opioids (morphine or ketobemidone) were given doses less than recommended. The recommended intravenous dose of morphine and ketobemidone for acute and postoperative pain in children is 0.05–0.1 mg/kg, and repeated doses might be required to achieve an adequate effect (3, 30), which was the case in our study, where more than half of the children needed repeated doses of opioid to relieve their pain. This aligns with both measurements (PNKAS-N and interviews with children) and reveals that nurses lack knowledge in pharmacological management, children experience pain and PONV, it is difficult to swallow tablets and unpleasant to receive

suppository, and the children recommended the nurses give pain medication when they need it. Other studies also found suboptimal pediatric pain management practice (12, 111, 117, 122), where practice did not concur with hospital or unit protocol (111), nurses were reluctant to give opioids (121), children received inadequate doses of analgesics according to the analgesic ladder (12), and many children experienced PONV (112). Another reason for suboptimal pharmacological pain management in the present study may be that physicians lacked knowledge about the limitations of prescribing analgesics. Insufficient or lack of prescription of medications has been reported to be a barrier to pain management in previous studies (9, 174, 175, 195, 196). Furthermore, at the current time, when conducting this study, there were no national guidelines in pediatric pain management in Norway, and the local guidelines were not well known or evidence-based.

Nonpharmacological techniques, such as cognitive, behavioral, physical, and supportive therapies, are effective in relieving pain in children (3). In the present study, nurses were frequently observed using nonpharmacological pain-relieving techniques, such as emotional support, creating a comfortable environment, and cognitive-behavioral methods (e.g., preparatory information and distraction). This does not concur with previous studies conducted in surgical wards that found limited use of nonpharmacological pain interventions (120, 123). However, physical methods such as thermal regulation (heat and cold), massage, or positioning, singing, music, skin-to-skin contact, nonnutritive sucking, sweet-tasting solutions, and facilitated tucking and swaddling were seldom used in the PACU. Furthermore, nurses seldom used phones, tablets, toys, books, magazines, or television as distraction techniques. These techniques have all been shown to be effective in relieving pain (3, 47, 49, 197, 198). The reasons for this may be that the participants lack knowledge and skills regarding the use of nonpharmacological pain-relieving techniques, especially for small children and neonates, and lack of available nonpharmacological equipment in the PACU.

In the present study, the children described different helpful nonpharmacological techniques, such as positioning, relaxation, distraction, heat, and cold, emotional support, and helping with daily activity. However, the children reported a lack of preparatory information, and some did not have their parents present, despite the fact that children have the right to receive age-appropriate information and have their parents with them when admitted to the hospital by laws and regulations in Norway (18, 20, 21). However, the PNKAS-N revealed that nurses knew that parents should be present during painful procedures.

Combining the Measurements

When combining different measurements, as in this study, we sought a broader understanding of a phenomenon (154). The researcher should not expect identical findings but a wider, more complex picture to emerge than presented by single methods work alone (167). In our study, we found that the different measurements were complementary in some fields (e.g., pharmacological management), divergent (e.g., nonpharmacological management), and even contradictory in others (e.g., pain assessment).

As an example of contradictory results, nurses reported the use of pain assessment tools (assessed by PNKAS-N); however, the children reported little use of pain assessment tools (assessed by interviews), and few were observed in clinical practice using pain assessment tools (assessed by observing in clinical practice). We found a gap between what the nurses said they did, what was observed, and what was experienced by the children. This saying–doing gap is also found by others. Dihle *et al.* (199) observed and interviewed nine nurses about postoperative pain management for adults in surgical wards in two hospitals in Norway. They found that there were gaps regarding giving information, pain assessment, and pain management. Another study done by Twycross and Finley (122), who observed and interviewed nurses about postoperative pain management in children in a children's hospital in Canada, found that there is a gap between what nurses say is the overall aim of managing postoperative pain in children and what they do. Only 53% of the observed practices matched the nurses' overall aims.

In the present study, we also found a gap between what the nurses know and do regarding parents' presence and pain assessment tools. Other studies report gaps between what nurses know and do (119), what they know and document (200), what they document and do (123), and what they document compared to children's experiences (114). Shomaker *et al.* (114) found that children experience pain twice as often as documented by nurses. Another study done by Twycross and Collis (123) found that nurses did not always document pain assessment or pain-relieving interventions. Further, they revealed that children and parents appeared to be satisfied and that their pain management was at an acceptable level or very good, despite 82% experiencing moderate to severe pain. Furthermore, a study done by Twycross (119) found no positive relationship between nurses' level of knowledge and clinical practice. However, in our study, we found that knowledge and clinical practice were most often related. The reasons for the gap in our study may be, in part, the organizational

barriers identified at T1. For example, some units had long distance between the surgical unit and the PACU. Therefore, it took time for parents to come to the PACU. If nurses do not know, they do not act. However, even if the nurses know, they may not act in line with the knowledge if there are barriers, such as lack of tools and lack of time (9).

In the present study, we found that using the different measurements gained a broader view and understanding of pain assessment, and most findings were complementary. For example, when looking at pain assessment, the questionnaire revealed that the nurses had some knowledge about pain assessment, but the PNKAS-N did not include specific questions regarding different pain assessment tools or how to communicate with children in pain. From observing the nurses' clinical practice, we learned how they assessed pain, whether or how they asked the children about pain, and whether they used tools. From the interviews with the children, on the other hand, we learned how the children experienced pain assessment and why they did not tell the nurse when they were in pain. This is clinically important because unrelieved pain can lead to unnecessary suffering, increased distress (6, 201) and pain response (27-29), and increased risk of complications and chronic postsurgical pain (8, 202, 203).

Another example from the questionnaire regarding nonpharmacological pain management was that the nurses had knowledge about nonpharmacological management methods that included parents' presence, relaxation, use of nonpharmacological techniques when in severe pain, and combining nonpharmacological and pharmacological techniques. However, there were not many questions about that in the PNKAS-N. From the observational study, we observed that many nurses used many different nonpharmacological techniques (e.g., parents' presence, preparatory information, distraction), but only through interviews with children did we learn what the children experienced helped relieving pain (e.g., parents' presence, preoperatory information, distraction, relaxation, positioning, and heat and cold), and what did not. Although the nurses were observed using preparatory information, and most parents were present during the whole time when the children were in PACU, the children who did not experience this recommended that the nurses secure that parents were present at all times, make more use of preparatory information, and elaborate on why and what kind of information they needed. This is clinically important, because common stressors and fears are separation from caregivers, fear of strangers, loss of control, fears of bodily injury and concerns about pain (204), and lack of preparatory information and parent's not present can

lead to increased anxiety (205, 206), reduce the chance for children to feel safe and cope, and increase pain (206). However, the children reported various techniques helpful despite not often being observed used in clinical practice (e.g., heat and cold, positioning) and gave recommendations to both nurses and other children on how to improve pain management based on their experiences, which are valuable information that should guide the improvement in pediatric postoperative pain management.

Regarding pharmacological pain management, the survey revealed that the nurses lack knowledge, and from the observational study, we learned that nurses gave the smallest amount of prescribed opioids, the children received inadequate doses of opioids, and very few received both paracetamol and NSAID. Furthermore, many received paracetamol as a rectal suppository or tablet. When the children interviewed explained that they experienced moderate to severe pain, pharmacological pain management proved to be even worse. Some children received medication they were not able to swallow, or experienced it unpleasant to receive rectal suppository. Some children did not want to take the medication because they were afraid of PONV.

Children's Experiences of What Was Helpful

To know if postoperative pain management is effective, we need to talk to the patients. In the present study, the children provided valuable information about what they experienced as helpful in relieving pain after surgery (assessed by interviews with children T1 and T2). The most often reported methods to relieve pain were to get pain medication, but medication for nausea, and local anesthesia before getting venous cannula were also mentioned. Having their parents present was crucial for them because they felt safe; the parents comforted them, and helped them with relieving pain and daily activities. They described cognitive-behavioral methods that were helpful (e.g., preparatory information, distraction, relaxation), and they gave examples of different ways to distract themselves from pain, and to relax. Other methods they experienced as helpful included positioning and the use of heat and cold (ice cream, ice cubes, a warm or cold hand). Other studies have reported children's experiences pharmacological pain management was the most effective to relieve postoperative pain (130, 133, 134, 136), and that children who experienced using relaxation and distraction was helpful to relieve pain (129, 131, 134).

Children's Suggestions for Nurses and Other Children

The children interviewed gave suggestions on how nurses could improve pain management based on their own experiences. The suggestions were mainly about how to get more information and explanations (e.g., tell us about that it will hurt, what will happen, not to drink too much, about the tube, feeling dizzy, not feeling my hand), but also to ensure that the parents were present when they woke up after surgery, nurses to be with them, and to give them pain killers when needed.

Furthermore, the children gave tips to other children who were undergoing surgery about how they could distract themselves from pain (e.g., by thinking about other things, talking to others/nurses/parents/friends, playing, or reading), try to relax, trust the nurses and follow the orders to take medicine. Other studies have reported children's suggestions to improve postoperative pain by more use of distraction and positioning (133), creating a comfortable environment and having more meaningful activities (131), and to give more/stronger pain medication (131).

Based on these findings, there is a need for improvement, and children add valuable information on how to improve postoperative pediatric pain management. These findings add important information to the existing research and should be incorporated into the nursing curriculum and in-service pediatric postoperative pain management clinical training in the units.

Barriers and Facilitators to Pediatric Pain Management

In the present study, we identified several barriers to effective pain management: nurse-, physician-, patient-, and organization-related. As described in Substudy I, we identified nurse-related barriers, such as myths about children overreporting their pain and children who sleep in spite of pain. Despite the fact that more than half of the nurses were specialized nurses and had long clinical experience as a nurse and working in PACUs, they had knowledge gaps, lacked skills in pain management for children, and feared addiction and respiratory depression. The patient-related barriers identified were children not reporting pain because they thought the nurse knew, trying to endure the pain, or not wanting pain medication because they were afraid of PONV. The physician-related barriers revealed in the study were insufficient or nonprescription of analgesics, and organization-related barriers included not

having evidence-based pediatric pain management guidelines and pain assessment tools available in the units.

Other studies have identified nurses' limited knowledge and clinical experience (83, 207-210), fear of addiction and respiratory depression (83, 93), insufficient or nonprescription of analgesics (211, 212), and lack of pain assessment tools (210, 213-215) as barriers to effective pain management for children. However, none have reported, to our knowledge, the patient-related barriers listed above. Other studies have reported that children are reluctant to take medicine because of their bad taste, because it is difficult or painful to swallow, or because they become nauseous (129, 134). Surprisingly, in our study, the children were offered pain medication that they were not able to swallow without getting another option (e.g., mixture or intravenous). This finding provides value to the existing research by offering a broader view of pediatric postoperative pain in PACUs. These findings are especially important to address in order to improve pain management and reduce the risk of undertreatment.

6.2.2 Effects of the Tailored Educational Intervention

PNKAS-N

In the intervention group, a significant improvement in the estimated PNKAS-N mean score was revealed between T1 and T2. The increased in knowledge observed in the present study concurs with the nurses' self-evaluation after the intervention, where they reported increased knowledge regarding pediatric postoperative pain management. The improvement was sustained at T3. Compared to similar studies using PNKAS to measure nurses' knowledge improvement after intervention, some significantly improved (13, 15, 16, 94-99). One study found no improvement (12). However, in our study, when controlling for baseline differences, there were no overall statistically significant differences in change between the two groups. This concurs with a study done by Johnston *et al.*(14). Only the study done by Johnston *et al.* (14) and our study had a control group. The reasons for the lack of significance may be due to the heterogeneity within the clusters and the use of ITT analysis, which may increase the chance of type II error. We also found increased knowledge within the control group, despite the fact that they did not receive any intervention. The reasons for this improvement in the control group may be that they were triggered to learn more about pediatric pain management because of the focus when participating in the study. Improvement in the control group were

also found in a similar study (14). However, the improvement in both groups is clinically important for pediatric pain management if nurses use the knowledge in clinical practice.

Pain Assessment

In the observational study, a statistically significant improvement in nurses' use of pain assessment tools was revealed in the intervention group between T1 and T2. The improvement was sustained at T3. In the questionnaire, improvement was revealed in nurses' knowledge of pain assessment items in the intervention group, but not in the control group. This is supported by the findings in the interviews with children who described the increased use of pain assessment tools in the intervention group. The increased knowledge revealed in the questionnaire concurs with nurses' self-reported evaluations of clinical supervision in pain assessment, what we observed in clinical practice, and the interviews with children. Some studies that used chart reviews found increased documented use of pain assessment tools (11, 12, 15, 16). Other studies (14, 142) also found increased documented use of pain assessment tools, but proved not to be statistically significant.

The present study revealed improvements in pain assessment for children 0–5 years from T1 to T2. This is clinically important because these are vulnerable children who are unable to self-report their pain and are therefore totally dependent on healthcare professionals.

Pain Management

Increased use of NSAIDs combined with paracetamol was revealed in the intervention group between T1 and T3, but it was not statistically significant. However, significantly increased use of intravenous paracetamol between T1 and T3 after intervention was revealed. This is important because the children indicated that they had difficulty swallowing tablets and experienced it unpleasant to receive a rectal suppository. Furthermore, administering intravenous paracetamol is advantageous because it provides a faster onset of pain relief (216), and when the oral or rectal route is unsuitable or ineffective (217).

An increased use of more adequate doses of morphine was revealed, but proved not to be statistically significant. Improvement was revealed in nurses' knowledge in the pain management items in the intervention group in more than half of the pharmacological items, and in seven of the ten questions most often answered incorrectly at T1 (e.g., respiratory depression, drugs useful for treatment of pain in children, and addiction). These findings are supported by the nurse's evaluation of the intervention, where they reported gaining new

knowledge and lectures about pharmacological management as most useful, and in the interviews with children, where they described less severe pain in PACUs.

The increased, but not significant, use of analgesics concurs with a study done by Johnston *et al.* (14). However, Heinrich *et al.* (142) found increased use of analgesics, Vincent *et al.* (16) found that nurses administered significantly more ibuprofen and ketorolac after intervention, and Rosenberg *et al.* (99) found increased use of topical lidocaine, but Le May *et al.* (15) found no documented change six months after intervention. We know that increased knowledge does not necessarily improve clinical practice, and that it may take 17 years to translate research into practice (218). The "know–do" gap can result in suboptimal care (219).

The reasons for not significantly increased use of analgesics in the present and previous studies may be that nurses were mainly in focus and pharmacological pain management may be seen as the physicians' responsibilities. Insufficient prescription of analgesic drugs is a barrier to effective pain management for children (9, 174, 175, 195, 196). In order to change clinical practice in pharmacological pain management, there may be a need to include physicians more throughout the project.

An increased use of nonpharmacological pain management was revealed in both groups. In the intervention group, a significant increase in use was revealed between T1 and T3 of preparatory information and comforting/reassurance, and an increased but not significant use of distraction, positioning, and heat and cold between T1 and T2. This concurs with the PNKAS-N, where all nonpharmacological items improved significantly after intervention in the intervention group, but only in one nonpharmacological item in the control group. Importantly, this improvement is in what the children had pointed out in the T1 interviews (Substudy II) about what helped them and what could be improved (e.g., preparatory information). Other studies found no significant increase in documented use of nonpharmacological pain-relieving techniques (14, 142), however Le May *et al.* (15) found increased use from T1 to T3.

6.3 Ethical Considerations

In the research studied, it is important to consider the risk/benefit ratio, and to minimize the risk to participants (154).

This study needs to be conducted with caution. The researchers collected a huge amount of data regarding both nurses' knowledge and clinical practice and identified knowledge gaps and a lack of skills. During the observational study, the researcher was in the units for a long period at each measurement point. This may be experienced as invasive for the nurses working in the units, and precautions were taken. Observation studies, especially if one observes a vulnerable group such as children, require high levels of ethical care (187). To minimize inconvenience, the PhD student undertook all the observations and sat in a corner of the room without disrupting nursing care. It is important to use many social strategies and skills to maintain relationships in the field (151). One must gain trust and relationships with those observed, as well as mitigate possible fears. The PhD student therefore used time in the PACUs to get to know the participants, gain their trust, and assure them that participation was voluntary. The data collection was done at all university hospitals; however, Norway is a small country, and the publication of these results needs to be done with caution to protect confidentiality. To ensure this, the data were handled with care and in accordance with ethical laws and regulations (157, 158), and the publication only revealed results per intervention and control group and not per unit/hospital.

In pediatric postoperative pain management, it is of great importance to explore children's experiences. As stated in Article 12 of the UNCRC, the child's right to participation and, if capable of forming his or her own views, the right to express those views freely in all matters affecting the child (18). Considering the vulnerability of children, several precautions were taken to ensure that the risk and inconvenience would be as insignificant as possible, and for patient protection.

The children and their parents who consented to participate in the interviews received verbal and written information about the study. Three different information letters were used, one for children aged 6–11 years, one for children aged 12–18 years, and one for parents, to ensure that the information was age appropriate. Because there were no information letter templates for children available from REK at the time of the study, which started in 2014, we developed one for children aged 6–12 years and one for children 13–18 years old. These were then sent to our hospital youth council and adjusted based on their recommendations, and thereafter approved by REK. The letters included information about the study and what would happen if they took part in the study, and indicated that it was voluntary to participate. The children were told that they could leave the study at any time without providing a reason and that

doing so would not impact the care they received. Further, it was pointed out for the children that they could stop at any time during the interview if they needed a break, were in pain, or did not want to continue. As elaborated on in Section 6.1.4, interviewing children is challenging; there is a power imbalance between the interviewer and the child, and the children are being interviewed in an unfamiliar environment. Therefore, the interviewer spent time with the children to get to know them a little and gain their trust. Furthermore, the parents could be present during the interview, and the researcher used a toolbox to help the children visualize their experiences and assure them that there were no right or wrong answers.

Informed consent was obtained from all children and their parents, and written informed consent was obtained from all parents and from children aged 12 years and older who were interviewed, according to the Health Research Act, § 13 and § 17 (158).

The interviews were coded so that no data collected could identify the child. Only the research team had access to the raw data, which were stored securely to ensure that confidentiality was maintained. There were low potential risks or disadvantages for the children, the involved children did not averse to it, the research might be useful to other children of the same age, and could not have been done on patients of other age groups (e.g., § 18) (158).

6.4 Strengths and Weaknesses of the Study

The main strengths of the present study are as follows:

- A cluster randomized design using different methodological approaches was chosen for this study. A strength of the present study is the combination of methods and sources. Three methodological approaches, including qualitative and quantitative measurements using multiple triangulations, were used to gain broader insight into pediatric postoperative pain management.
- Developed a tailored educational intervention based on previous research and baseline data (e.g., PNKAS-N, observational study, and interviews with children).
- Research related to pediatric postoperative pain management is considered to be of great importance to children undergoing surgery. This study adds knowledge on how to understand the complexity of pediatric postoperative pain management.

- The study was a multicenter study that included all six university hospitals in all health regions in Norway.
- The PNKAS-N used in our study was previously translated, tested, and validated into Norwegian settings.
- Both the observational study checklist and the interview guide were pilot tested.
- The analysis used ITT principles.
- Interviews with children provided useful insight into children's experiences about postoperative pain management in PACUs, and identified areas for improvement and suggestions on how to improve.

The main weaknesses of the present study are as follows:

- A cluster trial with few PACUs resulted in high degree of heterogeneity in the sample, e.g., large between-cluster differences and statistically significant differences between the intervention and control groups at baseline, and large variations within the clusters (e.g., the study was underpowered to reveal the predefined between group difference as statistically significant as the observed variation was larger than anticipated).
- Pain management needs a multidisciplinary approach, but we mainly focused on the nurses, which is preferable with a multidisciplinary focus in future studies.
- The participants were blinded at baseline, but it was not possible to blind nurses at T2 and T3 or blind the PhD student who conducted the study.
- Educational day was offered only one day, despite there being evidence that repeated intervention may be needed to achieve KT in clinical practice. To enhance KT, we included reminders and implementation teams in PACUs in the intervention groups. However, the implementation teams were small and vulnerable.
- We interviewed the children about their experiences. This was very valuable, but we should have used knowledge users (e.g., children) actively during the study.
- We evaluated possible effects one and six months after intervention; however, it takes time to change practice, and more longitudinal studies are needed.
- We had a high attrition rate. Almost half of the dropouts of the nurses were because they had quit during the study. PACUs are busy units with high turnover, where nurses often work before they specialize to be critical care nurses.

7 CONCLUSIONS

This thesis aimed to provide a broader insight into pediatric postoperative pain management in PACUs in Norway, and to determine the feasibility and effects of a tailored educational intervention. To our knowledge, this is the first study to measure nurses' knowledge of pediatric pain management, observe pain management in clinical practice, and explore children's experiences regarding pain and pain management in PACUs. By combining the measurements, we gained a better understanding of pediatric postoperative pain management. Our study has added valuable knowledge to existing research in this field.

The present study revealed suboptimal pediatric postoperative pain management and identified barriers to optimal pain management on many different levels. Nurses lack knowledge and skills in key topics in pediatric pain management. There is also a lack of national guidelines, little use of pain assessment tools, and insufficient pain medication. The children who participated in this study reported that they experienced moderate to severe pain, and some did not tell the nurses when they were in pain. They also reported having pain in places other than the surgical wound, and that experiencing PONV was unpleasant and painful. However, the children explained why they did not tell the nurses if they were in pain, what helped them relieve pain, and had suggestions on how to improve pain management.

The tailored intervention aimed to address the identified barriers, and we revealed a positive change in postoperative pain management knowledge and clinical practice. Nurses' knowledge improved in the intervention group; however, when adjusted for baseline differences, there were no statistically significant differences in change between the two groups.

7.1 Implications for Practice

Every day, many children undergo surgery, and PACU nurses play an essential role in pain management. The present study identified barriers (such as a lack of nurses' knowledge and skills) concerning crucial topics in pediatric pain management and revealed suboptimal pain management. Furthermore, the children experienced moderate to severe pain. This is clinically important because unrelieved pain can lead to unnecessary suffering, complications, and chronic postsurgical pain. Based on the findings, we suggest that pediatric pain management practices in PACUs in Norway require improvement. Furthermore, the children

provided valuable information on what to improve and how to improve postoperative pain management. These results should direct future improvements in pediatric postoperative pain management.

There appears to be a need to emphasize these topics in nursing curricula, and to conduct on-going in-service clinical training in hospital units to improve performance in pediatric nursing, and pediatric postoperative pain management.

7.2 Implications for Research

In the present study, we aimed to gain a broader insight into pediatric postoperative pain management, and to determine the feasibility and effects of educational intervention. This study provides a more in-depth understanding of pediatric postoperative pain management and children's' experiences of pain and pain management. However, this study did not aim to explore nurses' perspectives, which could have provided a better understanding of their experiences regarding pediatric postoperative pain management, their reflections on their own clinical practice, and possible barriers and facilitators they might experience to prevent optimal pain management. Furthermore, we did not measure physicians' knowledge, which is of great importance because physicians are responsible for prescribing pain medications.

Although our study showed positive changes in some areas of pediatric pain management after the intervention, there is a need for more studies to explore the effects of educational interventions to change clinical practice. Future research should focus on more robust studies with larger samples and a multidisciplinary approach. Furthermore, there is a need for longitudinal studies addressing multifaceted and multilevel barriers and facilitators to gain sustainable improvements in pediatric postoperative pain management.

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I

Original Article

Nurses' Knowledge, Attitudes and Clinical Practice in Pediatric Postoperative Pain Management

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Abstract:

Background: Despite readily available evidence to guide practice, children continue to experience moderate to severe pain in hospital postoperatively. Reasons for this may include attitudes of nurses toward pain management and their lack of knowledge in key areas. Aims: To identify nurses' knowledge and clinical practice of pediatric postoperative pain management and whether there is a link between knowledge and practice. Design and setting: A descriptive cross-sectional study including a questionnaire and observations was conducted in postanesthesia care (recovery) units in six university hospitals in Norway. Methods: Nurses completed the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain Questionnaire–Norwegian Version (PNKAS-N). We observed their clinical practices using a structured observational tool and field notes. Results: Nurses completed the PNKAS-N (n = 193) and were observed (n = 138) giving postoperative care to 266 children (70 hours per unit, 416 hours in total). The mean PNKAS-N score was 29 (standard deviation 4.2) of 40. We identified knowledge deficits, mainly in pharmacologic management, such as in risk of addiction and respiratory depression. We found that, overall, pain was assessed using validated tools in 19% of the children; this fell to 9% in children aged < 5 years. More than 66% of children received an inadequate dose of morphine postoperatively. Conclusion: Nurses have knowledge deficits about pediatric pain management and do not always use their knowledge in practice, particularly in relation to pain assessment. There is a need to improve nurses' knowledge of pediatric pain management and to test interventions that support the use of that knowledge in practice.

Pain in children and adolescents is underestimated and undertreated (IASP, 2011, 2017; Twycross, Forgeron, & Williams, 2015), and children report moderate to

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severe pain after surgery (Sng et al., 2013; Twycross & Finley, 2013). Stevens et al. (2012) found that one third (33%) of the hospitalized children experienced moderate to severe pain. This high number of children experiencing pain after surgery persists despite readily available evidence to guide practice (Hauer, Jones, Poplack, & Armsby, 2017; Howard et al., 2012). As late as the 1980s, premature and newborn children underwent surgery without pain medication (Olsson & Jylli, 2001). Peters et al. (2005) found that preterm infants are hypersensitive to pain. Surgery in neonates can lead to prolonged pain and hypersensitivity in the surgical area (Anand, Gracia-Preats, & Kim, 2017; Vinhall & Grunau, 2014), and deleterious effects on pain response and neurodevelopmental outcome have been described (Anand et al., 2017). Undertreated pain causes unnecessary suffering, an increased risk of complications, and increased risk of morbidity, as well as potentially leading to longer hospital stays (IASP, 2011). In the longer term, inadequate acute pain relief in children may lead to the development of chronic pain (Batoz et al., 2016; Fortier, Chou, Maurer, & Kain, 2011; Kristensen, Ahlburg, Lauridsen, Jensen, & Nikolajsen, 2012; Nikolajsen & Brix, 2014).

Nurse undertreatment of pain in children and adolescents is a consequence of pain management knowledge deficits, at least in part (Twycross, Forgeron, et al., 2015). The knowledge and attitudes of nurses regarding pediatric pain management has been identified in several studies using the Pediatric Nurses' Knowledge and Attitude Survey Regarding Pain Questionnaire (PNKAS) (Ekim & Ocakci, 2013; Hovde, Granheim, Christophersen, & Dihle, 2012; Lobete Prieto, Rey Galán, & Kiza, 2015; Lunsford, 2015; Omari, 2016; Ortiz et al., 2015; Stanley & Pollard, 2013; von Lutzau, Hechler, Herzog, Menke, & Zernikow, 2011). Findings from these studies indicated knowledge deficits in pharmacologic issues, such as the risk of respiratory depression (Omari, 2016; Stanley & Pollard, 2013; von Lutzau et al., 2011), risk of addiction (Ekim & Ocakci, 2013; Omari, 2016; Ortiz et al., 2015; Stanley & Pollard, 2013), and the conversion of morphine doses from intravenous to oral administration (Ekim & Ocakci, 2013; Omari, 2016). Knowledge deficits in pain assessment issues were also identified, such as a belief that children overreport their pain (Ekim & Ocakci, 2013; Stanley & Pollard, 2013) and the efficacy of adjunct nonpharmacologic methods of pain management (von Lutzau et al., 2011).

Knowledge deficits offer only a partial explanation for suboptimal practices. Underestimation of pain in children, for example, can be related to less than optimal pain assessment, and the lack of routine use of pain assessment tools in some units (Simons & Macdonald, 2004; Smyth, Toombes, & Usher, 2011). There are several pain assessment tools that can be used for children (behavioral scales, faces scales, numerical scales) (Chou et al., 2016; Keels et al., 2016; Royal College of Nursing, 2009; Stinson & Jibb, 2014), but no single tool is suitable for children of all ages (Ghai, Makkar, & Wig, 2008). Patient self-reports or observational pain assessment tools should be used to assess pain in children depending on their age (Hauer et al., 2017). Smyth et al. (2011) found nurses, in their study, were largely unaware of the pain assessment tools used on pediatric wards and did not use formal pain assessment guidelines, with some nurses emphasizing physical indicators of pain. Pediatric pain management clinical practices do not always conform to current best practice, and this lack of conformity is a challenge (Smyth et al., 2011; Twycross, 2007a; Twycross & Collis, 2013; Twycross, Finley, & Latimer, 2013).

Dihle, Bjølseth, and Helseth (2006) observed and interviewed nine nurses about pain assessment, giving information to, and pain management for, adults on surgical wards. They found difference between what nurses said they did and what they did in practice. Pediatric nurses behaved similarly (Twycross, 2007b), but this inconsistency has not been explored in pediatric pain management in postanesthesia care (recovery) units (PACUs). Children still experience unrelieved moderate to severe pain postoperatively and so it is important to identify the cause of this unrelieved pain. The purpose of the present study was to identify nurses' knowledge, attitudes, and clinical practices of pediatric postoperative pain management in PACUs and to determine whether there is a link between knowledge and actual practice, using a combination of various methodologic approaches to obtain new information in this context.

METHODS

Before the study started we obtained approval from the Regional Committee for Medical Research Ethics (REK South-East, Norway, ID: 399805), from the Head of Research at each hospital, and from the privacy ombudsman. We collected data from August to October 2014. The researcher met with unit managers to present the study and to discuss the study process, and all unit managers were happy for their nursing staff to participate in the study. All the nurses working in these units were then invited to participate. They received an information letter that included information about the study and explained that participation was voluntary and that responses would be treated

anonymously. We obtained written informed consent to participate from the nurses completing the questionnaire. We also obtained informed consent from the participants (nurses, children, and their parents) during the collection of observational data.

Sample and Setting

The study was conducted in all six university hospitals in Norway. Nurses (n = 259) working with children at the six largest PACUs were invited to complete a questionnaire (PNKAS-N) about knowledge and attitudes toward pediatric pain management. The same nurses who were invited to complete the questionnaire were also observed in clinical practice if they were on duty in the selected observational period. Five of these units have both children and adults. Each unit had 30 to 60 nurses, and usually between 5 and 15 children underwent surgery daily (Monday-Friday).

Data Collection

We used a combination of methodologic approaches in the present study. Data were collected about nurses' knowledge and attitudes using a questionnaire (PNKAS-N), and observational data about clinical practice were collected using a structured tool (checklist) and field notes.

We distributed a paper version of the PNKAS-N to all the nurses with an information letter and a return envelope. Participants also received verbal information about the study. The researcher observed the same nurses in clinical practice over a 2-week period in each unit. The researcher observed the children from the time they arrived until the time they left the unit and recorded which nurse cared for each child. The researcher sat in a corner of the room during the observations without disrupting the nursing care. The same researcher (the first author, A.H.S.) undertook all the observations.

Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain. We collected data regarding nurses' knowledge and attitudes toward pediatric pain management using the PNKAS-N. The original survey, the PNKAS, was developed by Manworren in 1998 (Manworren, 2001) and revised in 2002 (Rieman, Gordon, & Marvin, 2007).

The PNKAS was derived from best practice standards of pain management recommended by the World Health Organization, the Agency for Health Care Policy and Research, and the American Pain Society (Manworren, 2000; Rieman et al., 2007). The items in the survey cover general pediatric pain management, pain assessment, and pharmacologic and nonpharmacologic pain management. The PNKAS-N comprises 40 items, of which 23 are true or false statements, 13 are multiple choices, and 4 are based on two patient cases. Each item in the questionnaire is equivalent to 1 point, giving a scoring range from 0 to 40. The higher the score, the more correct answers were given. The revised PNKAS (Manworren and Shriners Hospitals for Children Version, 2002) (Rieman et al., 2007) was translated into Norwegian, tested, and validated according to Norwegian conditions by Hovde and colleagues in 2009 (Hovde et al., 2012). For the present study, an additional section was added to the questionnaire about the nurses' age, level of education, working experience and full-time equivalent, use of pain assessment tools, and whether the hospitals or units had guidelines for pediatric pain assessment and pediatric pain management.

Observational Data. The first author collected data regarding nurses' pediatric postoperative pain management practices using a structured observational tool (checklist) and field notes. The checklist was developed based on an extensive literature review (Twycross, Forgeron, et al., 2015) and current best practice guidelines (Hauer et al., 2017; Howard et al., 2012; Royal College of Nursing, 2009) and included the PNKAS-N themes (pain management, pain assessment, and pharmacologic and nonpharmacologic treatment of pain in children). The field notes included descriptions of what occurred during the period of nonparticipant observation and nurses' comments relating to pediatric pain management. The field notes were recorded while on the ward or directly afterward, depending on the situation at the unit. No identifying data about the children were recorded in the field notes, except weight, age, and type of surgery. The other data collected were situational, and care was taken to ensure patient confidentiality. The checklist was piloted on two occasions (observing for 3-4 hours each day for 2 days). After this, the structure of the checklist was adjusted to focus on the child rather than the nurse, because some children were cared for by more than one nurse.

Data Analysis

Descriptive and correlative statistics were used to describe and summarize the data from PNKAS-N using SPSS (IBM SPSS Statistics for Windows, Version 24.0. IBM Corp, Armonk, NY, USA). Means, standard deviations, medians, and interquartile ranges were calculated for continuous data. Frequency counts and proportions were calculated for categorical data. A one-way analysis of variance was used to determine whether significant variation existed among subgroups. Results were considered to be significant if $p < .05$. The observational data were analyzed using NVivo (NVivo11) and Excel (Excel 2016), and

frequency counts and proportions were calculated to summarize the data. For example, the number of times nurses used pain assessment tools was calculated and summarized in a table.

RESULTS

A total of 193 nurses completed the PNKAS-N (74.5% response rate). The mean age of the nurses was 42.9 years (standard deviation [SD] 10.0), and the mean number of years working as a nurse was 17.6 (SD 9.4). More than half were intensive care nurses (Table 1).

Observational data were collected for 2 weeks at each of the six hospitals and included that from management of 266 children who underwent surgery. A total of 416 hours was spent observing the pain management of these children. The main surgery groups were general (28%), orthopedic (27%), or ear/nose/throat (21%) surgery. More than half of the nurses (n = 138, 53%) working in the PACUs were observed on one shift or more. None of the nurses, parents, or children refused to participate in this observational study.

Total PNKAS-N Scores and the Association Between PNKAS-N and Education and Years in Clinical Practice

The mean PNKAS-N score was 28.8 (72% correct answers) with a range from 14-40 (range of 35%-100% correct answers). The 10 items most often answered incorrectly are listed in Table 2. Most of these items answered incorrectly related to pharmacologic management. The questions relating to risk of the child developing clinically significant respiratory depression was one of the most often answered incorrectly. The 10 items most often answered correctly are listed in Table 3. The item most often answered correctly (99.5%) was that the child or adolescent with pain should not be encouraged to endure as much pain as possible before resorting to pain relief.

As outlined in Table 4, specialist nurses scored significantly higher than nurses with only a bachelor's degree ($p = .020$). Furthermore, nurses who had worked in clinical practice for 15-27 years had significantly more correct scores on the PNKAS-N than nurses with less than 15 years' work experience ($p = .014$).

Pain Assessment

More than 90% of the nurse participants correctly answered 4 of the 13 items from the PNKAS-N about pain and pain assessment (Table 3). Questions often not answered correctly included the following: observable change in vital signs must be relied on to verify a child's/adolescent's statement that he or she has severe pain (42%), children may sleep in spite of severe pain (55%), children overreport pain (58%), and children younger than 8 years can report pain intensity (72%).

More than half of the nurses reported their units had written guidelines for pediatric pain assessment (55%) or pediatric pain management (59%). About 84% of the nurses reported they used pain assessment tools for children and adolescents. The visual analog scale (VAS) (51%) and the Face, Legs, Activity, Cry, Consolability Scale (FLACC) (24%) were reported as the

TABLE 1.
Background Characteristics of the Nurses (n = 193)

Characteristic	Mean (SD)	Range
Age (years) (n = 186)	42.9 (10.0)	23-63
Working experience as a nurse (years) (n = 193)	17.6 (9.4)	2-40
Working experience with children (years) (n = 175)	10.4 (9.2)	0-40
Working experience in current ward (years) (n = 174)	6.9 (7.0)	0-32
Educational level, N (%)		
Bachelor	65 (33.7)	
Specialist nurse*	128 (66.4)	
Master	6 (3.1)	
Nursing specialty, N (%)		
Intensive care nurse	108 (56.0)	
Pediatric nurse	16 (8.3)	
Other specialist nurses	4 (2.1)	

SD = standard deviation.

*To become a specialist nurse (intensive care or pediatric) in Norway requires the completion of an additional 1.5 years' education program after a bachelor's degree in nursing (a 3-year, full-time degree) at a university college or a university.

TABLE 2.
The 10 Questions Most Often Answered Incorrectly (n = 193)

Questions	n (%)
A child with background (continuous, persistent) pain has been receiving daily opioid analgesics for 2 months. The doses increased during this time period. Yesterday the child was receiving morphine 20 mg/hour intravenously. Today he has been receiving 25 mg/hour intravenously for 3 hours. The likelihood of the child developing clinically significant respiratory depression is (Less than 1%)	38 (19.7)
Which of the following drugs are useful for treatment of pain in children? (All of the above)	55 (28.5)
Narcotic/opioid addiction is defined as psychological dependence accompanied by overwhelming concern about obtaining and using narcotics for psychic effect, not for medical reasons. It may occur with or without the physiological changes of tolerance to analgesia and physical dependence (withdrawal) (<1%)	68 (35.2)
Patient A: Andrew is 15 years old and this is his first day following abdominal surgery. As you enter his room, he smiles at you and continues talking and joking with his visitor. Your assessment reveals the following information: BP = 120/80; HR = 80; R = 18; on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort), he rates his pain as 8 (Administer morphine 3 mg IV now)	69 (35.8)
Patient A: Andrew is 15 years old and this is his first day following surgery. As you enter his room, he smiles at you and continues talking and joking with his visitor. Your assessment reveals the following information: BP = 120/80; HR = 80; R = 18; on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort), he rates his pain as 8 (8)	81 (42.0)
Respiratory depression rarely occurs in children/adolescents who have been receiving opioids over a period of months (True)	88 (45.6)
Anxiolytics, sedatives, and barbiturates are appropriate medications for the relief of pain during painful procedures (False)	90 (46.6)
The recommended route of administration of opioid analgesics to children with background (continuous, persistent) pain is (Oral)	96 (49.7)
Infants/children/adolescents may sleep in spite of severe pain (True)	107 (55.4)
Which of the following IV doses of morphine administered would be equivalent to (Morphine 5 mg IV)	108 (56.0)

BP = blood pressure; HR = heart rate; R = respirations; IV = intravenous.

TABLE 3.
The 10 Questions Most Often Answered Correctly (n = 193)

Questions	n (%)
The child/adolescent with pain should be encouraged to endure as much pain as possible before resorting to a pain relief measure (False)	192 (99.5)
Parents should not be present during painful procedures (False)	189 (97.9)
The recommended route of administration of opioid analgesics to children with brief, severe pain of sudden onset, e.g. trauma or postoperative pain, is (IV)	189 (97.9)
After the initial recommended dose of opioid analgesic, subsequent doses should be adjusted in accordance with the individual patient's response (True)	184 (95.3)
Giving children/adolescents sterile water by injection (placebo) is often a useful test to determine if the pain is real (False)	183 (94.8)
Children who will require repeated painful procedures (i.e. daily wound care or blood draws), should receive maximum treatment for the pain and anxiety of the first procedure to minimize the development of anticipatory anxiety before subsequent procedures (True)	181 (93.8)
Young infants, less than 6 months of age, cannot tolerate opioids for pain relief (False)	181 (93.8)
Because of an underdeveloped neurological system, children under 2 years of age have decreased pain sensitivity and limited memory of painful experiences (False)	178 (92.2)
Analgesia for background (continuous, persistent) pain should be given (Around the clock on a fixed schedule)	178 (92.2)
The most likely explanation for why a child/adolescent with pain would request increased doses of pain medication is (The child/adolescent experiences increased pain)	178 (92.2)

IV = intravenous.

Table 4.
Differences in PNKAS-N Scores Related to Education, Age, and Work Experience

Characteristic	n (%)	*f*	*p*
Education			
Nurse with bachelor's degree	65 (33.7)	5.49	.020
Specialist nurse (pediatrics and intensive care)	128 (66.3)		
Age			
≤35	53 (27.5)	.98	.376
36–45	60 (31.1)		
>45	73 (37.8)		
Years of working experience as a nurse			
0-14	81 (42.0)	4.36	.014*
15-27	77 (39.9)		
>27	35 (18.1)		

PNKAS-N = Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain Questionnaire–Norwegian Version.
*Post hoc analysis revealed that the differences are between the youngest and the middle groups ($p = .018$).

most commonly used. However, we found that only 22% (31 of 138) of the nurses were observed using validated pain assessment tools with 19% (51 of 266) of the children. This was reduced to 9% (8 of 89) for children aged 0-5 years, and zero for children with cognitive impairment (Fig. 1). The most commonly used tool was the Numeric Rating Scale (23%; 31 of 136). One nurse used the Numeric Rating Scale on an 8-year-old child who was not able to answer because of cognitive impairment. The correct pain assessment tool for this child would have been Revised Face, Legs, Activity, Cry, Consolability Scale (r-FLACC).

Nonpharmacologic Pain Management

Four items from PNKAS-N were about nonpharmacologic pain-relieving interventions. Almost all participants (98%) correctly answered that parents should be present during painful procedures, and 91% correctly answered that the child or adolescent should not be advised to use nonpharmacologic techniques alone rather than concurrently with pain medications.

Nurses most often used "being present" (81%), "creating a comfortable environment" (69%), "preparatory information" (53%), and "distraction" (47%) as nonpharmacologic pain-relieving interventions. Parents most often used "being present" (96%), "creating a comfortable environment" (54%), and "touching" (37%), whereas children were observed to use relaxation and distraction (Table 5).

Nurses was observed using distraction techniques, including giving a bravery certificate (24%), small gift (11%), or hospital mascot (7%), or talking about other things. Two of six units routinely gave the children ice cream (lollipop ice) (12%) after surgery, and some gave children ice cubes to suck. Four of six units did not have toys, books or magazines,

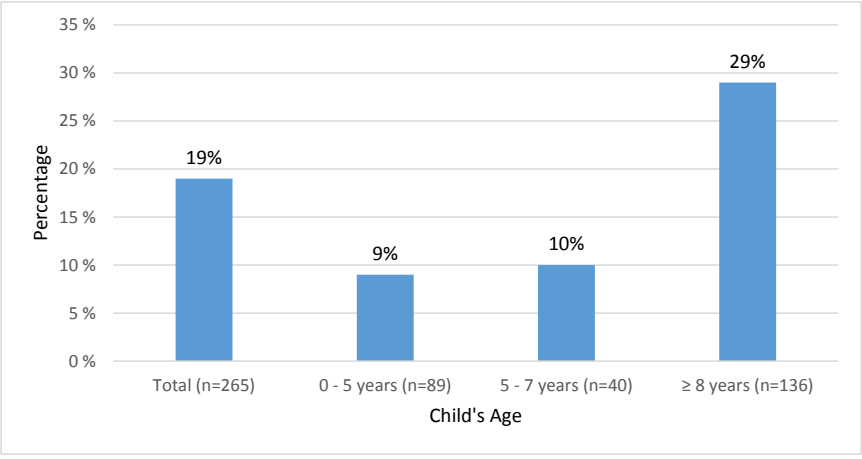

Figure 1. ■ Observed use of pain assessment tools by nurses per patient age group.

tablets, or a television available in the PACU. A summary of the observational data is presented in Table 5.

Pharmacologic Pain Management

More than half of the items from PNKAS-N were about pharmacological pain management. Eight of the 10 items most commonly answered incorrectly (Table 2) related to pharmacologic issues. Most common items answered incorrectly were those concerning risk of respiratory depression (20% answered correctly), useful drugs for treatment of pain (29%), and risk of opioid addiction (35%). When an adolescent patient said he was in pain, 42% of the nurses "believed" him and only 36% would have provided adequate pain medication.

The pharmacologic treatment given before, during, and after the surgery (in the PACU) was recorded. Acetaminophen (paracetamol) was administered to 85% of the children, a nonsteroidal anti-inflammatory drug (NSAID) to 26%, and both to 25%. An opioid was administered to less than half of the children (110 of 266; 41%) in the PACU. Morphine was administered intravenously in the range of 0.015-0.095 mg/kg (Table 5). The recommended intravenous dose of morphine for acute and postoperative pain in children is 0.05-0.1 mg/kg, and repeated doses might be required to achieve adequate effect (Howard et al., 2012).

More than two thirds (49 of 80; 61%) of the children who were administered morphine intravenously were given doses <0.05 mg/kg, and 49% (24 of 49) of these were given ≤0.03 mg/kg. Most children who were given a dose <0.05 mg/kg (35 of 49; 71%) needed repeated doses, sometimes three to six times, before their pain was relieved, which could take up to 1 hour. By contrast, only 4 of 21 children (19%) who were given a dose ≥0.05 mg/kg needed three or more repeated doses of morphine. In 31% (25 of 80) of the children, the prescribed dose of morphine was <0.05 mg/kg. If morphine or ketobemidone was prescribed on a sliding scale, for example as 0.05-0.1 mg/kg, 75% of the nurses gave the smallest amount of the prescribed opioid dose. In 63% of these cases, nurses needed to give repeated doses of opioid to relieve the child's pain. Nurses used pain assessment tools on 51 children, and 32 of these children received opioids, and 18 received opioids more than once. None of the children developed clinical respiratory depression during the observation periods. A summary of these observational data is presented in Table 5.

DISCUSSION

One important finding in the present study was that nurses had knowledge deficits in relation to pediatric pain management. There were inconsistencies between their knowledge and their observed pain assessment practices. The nurses in the present study had a mean PNKAS-N score of 72%, which is 13% lower than the level of knowledge accepted by most nursing standards (Omari, 2016; Stanley & Pollard, 2013). This level of knowledge is comparable to results found in some studies (Hovde et al., 2012; Johnston et al., 2007; Manworren, 2000; Rieman & Gordon, 2007; von Lutzau et al., 2011) but lower than in others (Le May et al., 2009; Rieman & Gordon, 2007; Smart, 2005; Vincent, 2005) that reported total mean PNKAS scores of 77%-81%. Importantly, when examining the range of scores, nurses in the present study scored 35%-100%. This means some nurses caring for children after surgery have a wide gap of knowledge in this context. Recent studies conducted by researchers from Mongolia (Lunsford, 2015) and Turkey (Ekim & Ocakci, 2013) reported total mean scores of 26% and 38%, respectively, but a variety of factors, such as different health care systems and cultures and differences in the role of the nurses, may account for this. It is crucial to determine the nature of the knowledge deficit more precisely.

Pain Assessment

Most of the knowledge and attitude items concerning pain assessment were answered correctly by the nurses. Similar results were found in two other studies (Hovde, Granheim, Christophersen, & Dihle, 2011; Rieman & Gordon, 2007). However, we found a gap between nurses' responses in the PNKAS-N and what they were observed practicing in relation to the use of pain assessment tools. Based on the PNKAS-N, 85% of the nurses reported using pain assessment tools and 55% responded that their units had written guidelines for pain assessment. About 80% of the nurses answered that the child is the best person to judge his or her pain intensity. However, only 22% of the nurses were observed using a valid pain assessment tool in practice, and only 19% of the children were assessed with a pain assessment tool in the PACU. Furthermore, most nurses (89%) answered that children who are younger than 8 years old can report their pain intensity, but the observational data revealed that only 10% of the children aged 5-7 years were assessed with a pain assessment tool.

Nurses' limited use of pain assessment tools is consistent with findings from other studies (Smyth et al., 2011; Taylor, Boyer, & Campbell, 2008; Twycross, 2007a; Twycross & Collis, 2013). This shortcoming has been attributed to a lack of knowledge and skills, attitude, absence of pain assessment tools, lack of time, or lack of evidence-

TABLE 5.
Observational Study Summary

Pain Assessed Using a Validated Pain Assessment Tool (N = 138 nurses, N = 266 children)
- Children's age: 0-5 years n = 89, 5-7 years n = 40, >8 years n = 136, 1 unknown)
- Numeric Rating Scale (NRS): Twenty-five nurses scored with NRS on 31 children.
- Visual Analog Scale (VAS): Four nurses scored with VAS on four children.
- Faces Pain Scale (FPS): One nurse used FPS on one child.
- Faces Pain Scale–Revised (FPS-R): Three nurses used FPS-R (one hospital) on three children.
- Color Analog Scale (CAS): Four nurses scored with CAS on four children.
- Face, Legs, Activity, Cry, Consolability Scale (FLACC): Seven nurses scored with FLACC on eight children.

Used Premedication (N = 266 children)
- Midazolam: Eighty-four children received midazolam preoperatively. (Five of six hospitals used midazolam regularly as premedication.)
- Acetaminophen (Paracetamol): A total of 107 children received acetaminophen preoperatively.
- NSAID (COX inhibitor): Six children received an NSAID preoperatively

Used Pharmacologic Methods of Pain Relief (Analgesic Drugs) (N = 266 children)
- Acetaminophen (Paracetamol): A total of 226 children received acetaminophen (107 preoperatively, 112 perioperatively, 7 postoperatively), and mainly as rectal suppository.
- NSAID (COX inhibitor): Seventy children received NSAID (6 preoperatively, 49 perioperatively, 15 postoperatively; 29 ketorolac, 32 diclofenac, 8 ibuprofen); 25 children had NSAIDs prescribed but not given.
- Dexamethasone: Eighty-four children received dexamethasone (4 preoperatively, 78 perioperatively, 2 postoperatively).
- Opioid Postoperative: A total of 108 children received opioid in single dose intravenously postoperatively, 80 morphine, 22 ketobemidone, 6 oxycodone, 3 fentanyl, IV morphine mean dose: 0.044 mg/kg (0.015-0.095 mg/kg), 60 children received IV morphine/ketobemidone <0.05 mg/kg. Some received three to six times. When morphine or ketobemidone was prescribed on a sliding scale, 20 of 24 children received the lower dose, and 15 of these children received a dose <0.05 mg/kg. Four children received morphine infusions, three children received subcutaneous pain infusions (morphine/ketamine), three children received slow-release oxycodone tablets, and four children received pethidine as rectal suppository.
- EDA: Twelve children received EDA.
- Neural Blockade: Four children received neural blockades.
- Clonidine: Six children received IV clonidine.

Used Multimodal Analgesia (N = 266 children)
- 65 children received both NSAID and acetaminophen

Nonpharmacologic Methods of Pain Relief Used in the PACU (N = 290 children)
- Physical measures
  - Massage: Two children received massage from their mothers.
  - Positioning: Twenty-seven nurses helped the children in a better position.
  - Some children lay still to avoid pain.
  - Thermal Regulation (Heat and Cold): Thirty-five nurses gave the children an ice cream (routine at two hospitals), eight nurses used warm sheets/blanket (at one hospital), six nurses used cold cloth on the forehead, and one child asked for a hot water bottle.
  - Some parents used their own warm or cold hand on the child
- Cognitive-Behavioral Measures

Preparatory Information at the PACU
- A total of 181 parents received verbal information from the nurses.
- Seventy children received verbal information from the nurses.
- Eleven children/parents received written information from the nurses.

Breathing Technique
- Two children received instruction in breathing technique by a nurse.

Relaxation
- Eighty-two children were sitting on their parents' lap.
- Forty children were carried or rocked by parents.
- Eight mothers were breastfeeding their child.
- Sixteen nurses/parents used singing or music.
- Eight children were sitting on the nurse's lap.
- Nine children were carried or rocked by nurses.
- Eighteen children used pacifier/dummy.
- Some children were sleeping or resting.

Distraction
- Seventy-three nurses gave the children a bravery certificate (routine at five hospitals).
- Forty-four nurses gave the children an ice cream (routine at two hospitals).
- Thirty-three nurses gave the children a small gift (routine at three hospitals).
- Twenty-two nurses gave the children a hospital mascot (at two hospitals).
- Thirty children played with parents/nurses (mostly parents).
- Twenty-four children read a book or magazine.
- Twenty-two children used a phone/tablets or watched DVDs/television.
- Some children talked with parents and nurses.

Emotional Support

Presence:
- Nurse present: A total of 284 children had nurses present.
- Parents present: A total of 278 children had mother/father present.
- A total of 223 children had their mother present.
- A total of 103 children had their father present.

	Fifty-two children had both parents present (four hospitals) Comforting/Reassurance Eighty-seven children were comforted by chat (parents or nurses); 47 parents used comforting chat, 41 nurses used comforting chat. Touch A total of 129 parents or nurses held hands or had their arms around the child or otherwise touched the child. Forty-six nurses were held hands or had their arms around the child or otherwise touched the child. A total of 107 parents held hands or had their arms around the child or otherwise touched the child. Helping in Daily Activities at the Recovery Unit A total of 105 children received something to drink (water/lemonade). Ten children received a biscuit to eat. Creating a Comfortable Environment A total of 232 nurses/parents behaved in a calm and quiet manner. Two hundred parents behaved in a calm and quiet manner. A total of 156 nurses behaved in a calm and quiet manner Fifty-nine nurses used other environmental measures. Forty-six nurses dimmed the light.

PACU = postanesthesia care unit; NSAID = nonsteroidal anti-inflammatory drug; IV = intravenous; EDA = epidural anesthesia.

based guidelines (Simons & Macdonald, 2004). One reason for this may be that nurses lack knowledge about children in general, and in particular in relation to communication with children. Effective communication with children requires using language appropriate to the child's age (Stinson & Jibb, 2014). Pain assessment will be influenced by how the nurses communicate with the child about pain, how they ask the child, and whether they expect the child to tell them when he or she is in pain. Furthermore, pain assessment and communication will be influenced by whether nurses are able to gain the child's trust and if they are aware of preschoolers' highly literal interpretation of words and inability for abstract thought (Hazinski, 2013).

Another reason for the difference in nurses' reported and observed practices may be a lack of knowledge about pain assessment and pain assessment tools for children, especially for small children. In the present study, nurses working in five of six units cared for both children and adults and were mainly intensive care nurses. Only 8% of the participants were pediatric nurses. There is minimal focus on children and on pediatric pain management in the standard curricula for nurses and intensive care nurses in Norway.

In the present study the researcher observed that very few pain assessment tools were in use in the units, and only a few nurses had their own pain assessment tools. None of the children with cognitive impairment were assessed with the r-FLACC scale (Malviya, Voepel-Lewis, Burke, Merkel, & Tait, 2006) or another appropriate pain assessment tool in the PACU. Pain in these children can be very difficult to assess because they may have different pain behaviors and therefore need a specific pain assessment tool, such as the r-FLACC (Pedersen, Rahbek, Nikolajsen, & Møller-Madsen, 2015). The r-FLACC is a behavioral tool that must be individualized for each child's pain behavior before the surgical procedure (Malviya et al., 2006). Thus, for the PACU nurses to be able to use the r-FLACC, they are dependent on the ward nurses to individualize it before the children arrive at the PACU, which was not done to our knowledge.

Limited use of pain assessment tools can also indicate that nurses think pain assessment tools do not reflect the complexity of managing pain in children in clinical practice (Franck & Bruce, 2009; Voepel-Lewis, 2011; Voepel-Lewis, Burke, Jeffreys, & Malviya, 2011) or that nurses emphasize physical indicators of pain (Smyth et al., 2011; Vincent & Denyes, 2004; Vincent & Gaddy, 2009; Vincent, Wilkie, & Szalacha, 2010). In the present study, there was a gap in knowledge concerning the use of vital signs to assess pain in children alongside a lack of pain assessment tools available in the units. Almost half of the nurses believed children overreported their pain. These issues may be barriers to optimal pain assessment and may provide an explanation for

why pain assessment tools are not used in practice. The difference between knowledge and attitude scores and observational data in this context may mean that nurses know that using a tool helps assess pain but for some reason do not use the tool in practice. Some researchers suggest that this could be attributable to organizational culture (Lauzon & Laurie, 2008; Twycross et al., 2013).

Nonpharmacologic Pain Management

In the present study, nurses had higher scores on items about the use of nonpharmacological methods for management of severe pain than those found in similar studies (Chiang, Chen, & Huang, 2006; Manworren, 2000; Smart, 2005; Vincent, 2005). The best practice of having parents present during painful procedures was identified correctly by 98% of the nurses. This finding is consistent with those of similar studies (Hovde et al., 2012; Manworren, 2000; Rieman & Gordon, 2007; Smart, 2005). Furthermore, the use of distraction was correctly identified by 72% of the nurses, which is higher than reported in studies by Ekim and Ocakci (2013) (53% answered correctly) and von Lutzau et al. (2011) (67% answered correctly).

The PNKAS-N data in the present study corresponded to the observational data that nurses in the PACU were often observed using nonpharmacologic techniques. This finding is somewhat different from those of studies conducted in two pediatric wards in England (Twycross, 2007a; Twycross et al., 2013; Twycross & Collis, 2013), where the investigators found that the reason for nurses' seldom using nonpharmacologic techniques was that they considered this to be the parents' role (Twycross & Collis, 2013). This difference may be the result of a greater focus on the use of nonpharmacologic pain-relieving strategies in Norway or because nurses' knowledge and attitudes have improved in recent years. In addition, nurses working in the PACU may see their role differently from nurses working in surgical wards and thus may approach the use of nonpharmacologic strategies differently.

In the present study the most commonly used nonpharmacologic methods were emotional support, such as being present and using touch; creating a comfortable environment; providing information; and providing distraction. Parents were allowed to be present during the time the child stayed in the PACU, and in four of the six hospitals, both parents were permitted to be present. Emotional support (comforting) and a physical method (positioning) were the nonpharmacologic methods most commonly used by nurses according to a study conducted at hospitals in Fujian Province, China (He, Vehvilainen-Julkunen, Polkki, & Pietila, 2007). Children considered that the most important strategy used by parents was for them to be present (He et al., 2007; Idvall, Holm, & Runeson, 2005; Sng et al., 2013), and they needed parents as their advocates (Sng et al., 2017).

Despite nurses' frequent use of nonpharmacologic methods, strategies such as singing, music, skin-to-skin contact, nonnutritive sucking, sweet-tasting solutions, and facilitated tucking and swaddling were seldom used in the PACU. Similarly, nurses seldom used phones, tablets, toys, books or magazines, or television as distraction techniques. These techniques have all been found to be effective in relieving pain (Harrison, Elia, Royle, & Manias, 2013; Hauer et al., 2017; Pillai Riddell et al., 2015; van der Heijden, Araghi, van Dijk, Jeekel, & Hunink, 2015; Wente, 2013).

Nurses may not know which nonpharmacologic pain-relieving methods are most effective. This was not specifically explored in the present study, but we found that a lack of available play equipment in the hospital environments, such as books, tablets, DVDs, and toys, limited the use of these nonpharmacologic strategies. Many children now have their own mobile phone, but in the present study very few used them during their stay in the PACU. When parents or children asked if they could use their phone or tablet, the nurses allowed them to do so, but not many children asked. Perhaps the children and their parents did not know whether they were allowed to bring their phone or tablet into the PACU or to use them in this setting.

Pharmacologic Pain Management

In the present study, nurses least often correctly answered items concerning the risk of respiratory depression, useful drugs for treatment of pain, and the risk of opioid addiction. These findings are consistent with those of other studies (Ekim & Ocakci, 2013; Manworren, 2000; Rieman & Gordon, 2007; Vincent, 2005). Most nurses (94%) knew that young infants, younger than 6 months of age, can tolerate opioids. For this question, only one other study had similar findings (Hovde et al., 2012). In more recent studies by Omari (2016) and Ekim and Ocakci (2013), only 29% and 24%, respectively, of nurses correctly answered this question. The PNKAS-N responses in this aspect of the study were consistent with the observational data, which were that 85% of children younger than 6 months of age received morphine in the PACU. However, the observed clinical practices did not always follow current international guidelines for pediatric pain management. For example, the choices of drugs, dosages, and how they were administered or

the use of multimodal pain management were not consistently compliant with the guidelines. The PNKAS-N findings identified a lack of knowledge about different types of pain medication and drug doses, corresponding to the findings of the observational study.

Multimodal pain management strategies should be used to treat postoperative pain in children (Conway, Rolley, & Sutherland, 2016), and although 85% of the nurses correctly answered the PNKAS-N question about combining different drugs, only 24% of the children were observed receiving acetaminophen combined with NSAIDs. More than half of the children (64%) were not prescribed NSAIDs. One reason for this may be the reluctance of surgeons in Norway to prescribe NSAIDs.

One hospital used pethidine postoperatively, even though the use of pethidine is not recommended for postoperative pain management in children (Howard et al., 2012). More than half of the children in the present study received suboptimal doses of morphine and required repeated doses, sometimes administered three to six times, before the pain was relieved, either because of suboptimal doses being prescribed or because nurses gave the lowest doses or even less than prescribed.

Fear of respiratory depression and opioid addiction may contribute to undertreated postoperative pain in children and adolescents (Seisser & Ward, 2002). In addition, lack of knowledge about recommended drug doses or the attitudes of nurses to pain, or both, may explain suboptimal administration practices (Hovde et al., 2012; Jacob & Puntillo, 1999; Vincent, 2005; Vincent & Denyes, 2004). Some nurses expect that children will have some pain after surgery (Twycross, Williams, & Finley, 2015). This may mean they wait to give pain relief or give a lower dose of an opioid than is prescribed.

Limitations

There are some limitations to the present study. Although pain management is multidisciplinary, we only focused on the nurses. It is important that both nurses and physicians have updated knowledge about pain management because they should be working together to relieve children's pain experience after surgery. However, this study does provide, for the first time, insight into how nurses manage children's pain in Norway as well as their knowledge deficits.

The PNKAS was developed in 1998, and the question about opioid addiction may no longer be valid (Manworren, 2014). The original answer stated that there is less than 1% risk of opioid addiction for patients treated for pain, which may be too low. Therefore, Manworren (2014) recommends that responses less than 1% and 5% should be both categorized as correct. Adjusting for this recommendation in the present study, this question would no longer be among the bottom 10 correctly answered questions, but the total mean score would remain the same. Furthermore, nurses were asked to report what they would do in clinical practice in hypothetical case-related questions that do not necessary reflect on actual practices. Another challenge in the present study is social desirability in the way that in self-reports, people (nurses) will often report inaccurately on sensitive topics to present themselves in the best possible light (Fisher, 1993). This phenomenon could be true because they might know what is most correct even if they don't perform it in their clinical practice.

Observation of nurses' clinical practice was only for a limited period, sometimes in very busy units, and it is possible not all details were recorded. Furthermore, it is difficult to know the justifications of nurses for their actions in pain management because the present study used a nonparticipant approach to observation. However, some nurses discussed pain management issues with other colleagues and some of these discussions were heard by the researcher. Despite these limitations, as noted before, this study provides an insight into Norwegian nurses' pediatric postoperative pain management practices for the first time.

Lastly, the present study has not covered the children's experiences of pain and pain management and has not fully explored their use of nonpharmacologic pain relief methods, and these items warrant investigation.

Implications for Nursing Practice

Nurses' lack of knowledge about pain assessment, not having pain assessment tools available in the units, and a belief that pain assessment tools are not useful, along with a tendency to concentrate on physical indicators of pain, may be barriers to optimal pain assessment.

Barriers such as a lack of knowledge about useful nonpharmacologic pain-relieving strategies or a lack of resources limit the nurses' use of these methods. Nurses should be encouraged to increase the use of nonpharmacologic pain-relieving strategies, including providing preparatory information and education for children and their parents about postoperative pain management.

There are currently no national guidelines in Norway for pediatric postoperative pain management. Although each unit had pain treatment guidelines, staff were not always aware of them, and the guidelines were not evidence based. This may contribute to the suboptimal pain management observed. Given this,

units should develop evidence-based guidelines in relation to pediatric postoperative pain management. The findings of this study also emphasize the need for continuing education in pain management for nurses. This education should use methods that facilitate the application of knowledge in practice.

Future Research Priorities

More studies in pediatric pain management should be conducted to determine why nurses do not use pain assessment tools in practice. Children's pain and pain management experience after surgery should be investigated, including which nonpharmacologic strategies the children experience as helpful. We recommend that intervention studies should be conducted to identify strategies for improving pediatric pain management and to improve the application of nursing knowledge in practice.

CONCLUSIONS

Based on the findings of the present study, we suggest that pediatric pain management practices in Norway require improvement. Nurses appear to lack knowledge in pediatric pain management, especially about pharmacologic matters. This concurs with observed clinical practice in this study where more than half of the children received inadequate doses of morphine. Furthermore, we found a discrepancy between nurses' PNKAS-N responses and their actual assessment of pediatric pain. Almost all the nurses answered correctly the items relating to pain assessment, but based on the observational data, 81% of the children did not have their pain assessed using a pain assessment tool. Clinical practices were not always consistent with international best practice guidelines, and there are no national guidelines for pediatric pain management in Norway. Only a few hospitals have their own guidelines, but they were not always well known or evidence based. There is a need to develop guidelines and to implement them in all hospitals.

The present study identifies a lack of knowledge concerning key topics in pediatric pain management, and there appears to be a need to emphasize these topics in nursing curricula to improve performance in pediatric nursing, communication with children, and pain management, and to strengthen the management of pediatric pain.

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ORIGINAL ARTICLE

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Children's views on postsurgical pain in recovery units in Norway: A qualitative study

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Abstract

Aims and objectives: To explore children's postsurgical experiences with pain and pain management in the recovery unit.

Background: Children's pain is underestimated and undertreated. Untreated pain can cause unnecessary suffering, increased complication risks and may lead to chronic pain. Research exploring children's experiences with postoperative pain and pain management is limited.

Design: A qualitative, exploratory study. The study complied with the Consolidated Criteria for Reporting Qualitative Research (COREQ).

Methods: Children (N = 20), 8–16 years old, took part in semi-structured interviews about their experiences with pain and postoperative pain management while they were in a recovery unit. Data were collected at two university hospitals in Norway. Content analysis was used to analyse the data.

Results: Three themes emerged from the interviews: "children's experiences of what felt unpleasant and painful," "children's experiences with pain management" and "children's recommendations for future pain management". About half of the children reported moderate to severe pain while in the recovery unit and they did not always tell their nurses when they had pain. They also reported experiencing pain in places other than their surgical wounds and stated that nausea and vomiting felt unpleasant and painful. The children indicated that pain medications and the use of nonpharmacological methods helped them cope with their pain and provided several recommendations about how to improve pain management.

Conclusion: Paediatric postoperative pain management remains suboptimal. The children in our study provided useful information about their pain experiences, how to improve pain management and explained why they did not tell their nurses when they were in pain.

Relevance to clinical practice: These findings should direct further improvements in paediatric postoperative pain management, such as increased use of pain assessment tools and preparatory information, as well as more appropriate administration of pain medications.

KEYWORDS

children, experience, pain, pain assessment, pain management, postoperative pain

1 | INTRODUCTION

Children's postoperative pain is underestimated and undertreated (Pope, Tallon, McConigley, Leslie, & Wilson, 2017; Sng et al., 2017; Twycross, Forgeron, & Williams, 2015). As a result, many children experience moderate to severe postoperative pain (Avian et al., 2016; Birnie et al., 2014; Kozlowski et al., 2014; Thienthong et al., 2014), which can cause unnecessary suffering and increase the risks of complications, morbidity and mortality, as well as potentially leading to longer hospital stays (IASP, 2017). A long-term consequence of inadequate relief from acute pain can be chronic postsurgical pain (CPSP), which is experienced by 10%–20% of children undergoing surgery (Batoz et al., 2016; Rabbitts, Fisher, Rosenbloom, & Palermo, 2017; Schug & Bruce, 2017).

The International Association for the Study of Pain (IASP) define Pain: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain is always subjective". (IASP, 1994). This definition emphasises the multidimensional aspect of pain. As pain is a biopsychosocial phenomenon, it requires a multimodal approach to management (Twycross & Williams, 2014). One reason for suboptimal postoperative pain management may be the complexity of assessing pain in children (Mennella & Heering, 2017; Twycross & Finley, 2013). Many nurses believe that children over-report their pain (Ekim & Ocakcı, 2013; Ljusegren, Johansson, Gimbler Berglund, & Enskar, 2012; Stanley & Pollard, 2013; Twycross & Collis, 2013) and thus use pain assessment tools inconsistently (Sng et al., 2013; Twycross & Finley, 2013) or use physical indicators of pain rather than the child's self-report to guide decision-making about appropriate treatments (Smyth, Toombes, & Usher, 2011). Further, nurses' beliefs and misconceptions (Twycross & Collis, 2013) or lack of knowledge (Ekim & Ocakcı, 2013; Ortiz et al., 2015; Smeland, Twycross, Lundeberg, & Rustøen, 2018) about paediatric pain management may be barriers to effective pain relief.

2 | BACKGROUND

In recent years, children's perceptions of postoperative pain have been explored in studies from Canada (Birnie et al., 2014; Twycross & Finley, 2013), Thailand (Thienthong et al., 2014), Australia (Ford, Courtney-Pratt, & FitzGerald, 2012), Singapore (Sng et al., 2013) and Sweden (Rullander, Jonsson, Lundstrom, & Lindh, 2013). These studies all support the notion that children continue to experience moderate to severe pain postoperatively. In the study by Rullander et al. (2013), several children also reported persistent pain 5–12 months after surgery. Children have described a range of negative emotions including anger, fear and sadness in relation to their experiences with postoperative pain (Ford et al., 2012; Sng et al., 2013; Twycross & Finley, 2013). Of note, for some children, nausea is worse than pain (Rullander et al., 2013).

What does this paper contribute to the wider global clinical community?

- The children in this study experienced moderate to severe pain and had pain in places other than their surgical wound site.
- The children did not always tell their nurses when they were in pain, and explained why.
- The children provided useful suggestions about how to improve paediatric postoperative pain management.

Children's views about their postoperative pain management have been explored in some studies (Ford et al., 2012; He, Vehvilainen-Julkunen, Polkki, & Pietila, 2007; Sng et al., 2013; Twycross & Finley, 2013). Children have reported that pharmacological pain management is the most effective way to relieve their postoperative pain and indicated that it is important that nurses give them medications when they are needed (He et al., 2007; Sng et al., 2013). In relation to nonpharmacological methods, children have stated that the most important thing parents could do to help them cope with their pain was to be present (i.e., with them in the hospital) (He et al., 2007; Sng et al., 2013). Some children have reported receiving inadequate preoperative information about what to expect in the postoperative period (Ford et al., 2012; Twycross & Finley, 2013). Some children have also suggested that there is a need for improved communication between nurses and parents—so that parents have enough knowledge to deal with their child's pain (He et al., 2007). Children have also recommended the use of more nonpharmacological pain management techniques, such as distraction and positioning (Sng et al., 2013).

The aforementioned studies provide evidence that children's perspectives on experiences of postoperative pain can provide insight into the improvements needed for their postoperative pain management. However, very little is known about children's experiences about pain and pain management within the recovery units. Nurses working in recovery units have an important role in assessing and managing pain in children and so more knowledge is needed in these areas.

2.1 | Aim

The study aim was to explore children's experiences with pain and postoperative pain management in Norwegian recovery units. We also sought to gain insight into children's recommendations for nurses about strategies that could improve paediatric postoperative pain management, and what advice they would give other children undergoing surgery. With an overarching goal of influencing future clinical practice, we aimed to gain a greater understanding of children's experiences and to gather their recommendations for improving postoperative pain management.

3 | METHODS

3.1 | Study design

This was a qualitative, exploratory study using semi-structured interviews of children after they had undergone surgery. This study focused on children's views and was part of a larger study; *Pediatric Pain Management —an Intervention Study* described at ClinicalTrials.gov (ClinicalTrials.gov Identifier: NCT03385681). The study complied with the Consolidated Criteria for Reporting Qualitative Research (COREQ) (Supporting information Appendix S1).

3.2 | Data collection

3.2.1 | Sample

We invited children 6 years or older who were undergoing elective or emergency surgery at two university hospitals in Norway to participate in the study. We excluded children with cognitive impairment who were unable to communicate verbally, those who did not speak Norwegian, and those who were admitted to the intensive care unit after surgery. All children who were interviewed were admitted to a recovery unit for both children and adults. Data were collected during October and November 2014.

3.2.2 | Data collection tools

Two different semi-structured interview guides were developed: one for children aged 6–11 years; the other for those 12–18 years. The interview guides were based on work by Polkki, Pietila, and Vehvilainen-Julkunen (2003) and by the Royal College of Nursing (2009) and included questions about what happened when they were in pain, if anyone asked if they were in pain, about what helped them when they were in pain and suggestions for nurses and other children who are undergoing surgery on how to manage pain. The interview guides were piloted on both age groups, after which a small adjustment was made, and an opening question added about why the child was hospitalised.

As part of the interview process, all children were also asked to rate the worst pain they had experienced during their stay at the recovery unit using a numerical rating scale (NRS) (von Baeyer et al., 2009) from 0 ("no pain")–10 ("worst pain imaginable") or the Faces Pain Scale-Revised (FPS-R) (Hicks, Baeyer, Spafford, van Korlaar, & Goodenough, 2001) depending on their cognitive abilities. Using the same scale, they were also asked to rate the worst pain experienced during their postoperative period and their current level of pain. Participants' age, gender, type of surgery, type of admission and pharmacological treatments administered before, during and after surgery (i.e., in the recovery unit) were recorded.

3.2.3 | Procedure

The nurses on the surgical wards identified children who met the inclusion criteria and asked if they were interested in information about the study. The children and parents who accepted the invitation were given more information by a researcher and were then given time to consider whether they wished to participate. During the 2 weeks of recruitment, 26 children met the inclusion criteria and 20 were enrolled (Figure 1).

All but two children chose to have their parents present during the interview. The interviews were audio-recorded and conducted

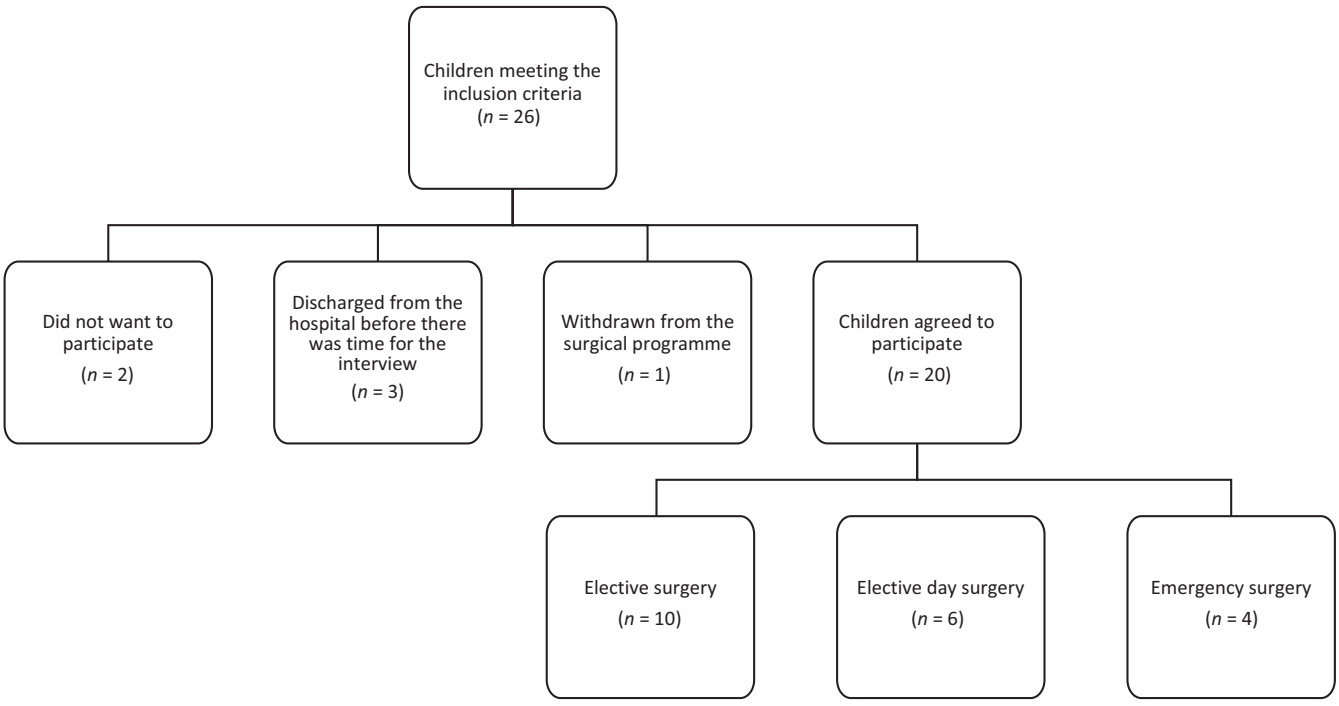

FIGURE 1 Recruitment of participants

after the children were discharged from the recovery units and before they were discharged from the hospital. Two researchers (LN and TN) conducted the face-to-face interviews, one interviewing and one observing. The one observing wrote down some field notes maintaining contextual details. Seventeen interviews were conducted within 48 hr after the child's surgery, and three took place between the third and fifth postoperative day. The interviews lasted 12–28 min and took place in a private room near by the recovery unit or on the surgical ward with only the interviewers and, if they chose, their parents present to ensure confidentiality and limit interruptions.

3.3 | Ethical considerations

Ethical approval was obtained from the Regional Committee for Medical Research Ethics (REK South-East, Norway; id: 399805) and both hospitals' local Social Science Data Services (NSD) and unit managers. Children and their parents received verbal and written information about the study. Three different age-appropriate information letters were used: one for children 6–11 years; one for children 12–18 years; and one for parents. These letters included information about the study and explained that participation was voluntary and that their responses would be treated anonymously. The children were told that they could leave the study at any time without providing a reason and that doing so would not impact on the care they received. Furthermore, it was pointed out for the children that they could stop at any time during the interview if they needed a break, were in pain or did not want to continue. We obtained verbal informed consent from all children and written informed consent from all parents and children 12 years and older. The interviews were coded so that children could not be identified. Only the research team had access to the raw data, which were stored securely to ensure that confidentiality was maintained. The study was registered at ClinicalTrials.gov (ClinicalTrials.gov Identifier: NCT03385681).

3.4 | Data analysis

The researcher who conducted the interviews also transcribed the children's responses verbatim using NVivo (QRS NVivo Pro for Windows, version 11). Content analysis was applied to the transcripts using a six-step approach (Creswell 2014):

1. Creating and organising data files
2. Reading through the text and forming initial codes
3. Coding all data
4. Describing the social setting, people involved and events
5. Analysing data to identify emerging themes
6. Interpreting and making sense of the findings.

Three researchers (LN, TN and AHS) independently analysed the data and then thoroughly discussed the themes until consensus was achieved. Each researcher referred to the themes by slightly different names, although their content was similar.

4 | RESULTS

Almost equal numbers of boys and girls aged 8–16 years participated. Their most common type of surgery was orthopaedic, and 16 of the 20 had undergone elective surgery. More than half of the children received intravenous opioids postoperatively. Background characteristics of the children are summarised in Table 1.

The three themes that emerged from the interview data will each be discussed in detail:

1. Children's experiences of what felt unpleasant and painful
2. Children's experiences with pain management
3. Children's recommendations for future pain management.

4.1 | Children's experiences of what felt unpleasant and painful

4.1.1 | My experience of pain in the recovery unit

Half of the children reported experiencing moderate or severe pain while in the recovery unit (Table 2). For some children, their postoperative pain intensity escalated during their hospital stay. Children used a variety of words to describe their pain. Some described it in detail while others used short sentences; their descriptions included words such as sore, tender, bumping, aching, prickling, burning, unpleasant and hurt.

One boy who had undergone emergency surgery and who had pain before the operation—but was not told it would hurt afterwards—described his experience:

> Researcher (R): "Do you remember how you were doing when you woke up the first time after the surgery?"; Child (C): (whispering) "Then it was…so painful that I thought I was going to die." (Case 12, 11 years)

This child explained that his pain was nine out of 10 on the NRS when he awoke after surgery. He explained that his pain score on the NRS prior to surgery had been an eight and that the pain after surgery felt different. One child described how it felt having pain when she breathed:

> R: "Can you tell me how the pain felt, or is that difficult?"; C: "I almost have it when I breathe, but it feels a bit as if…as if everything stops up inside me…that it sort of…it's like you sort of…if you have been a long time under water and longing to get up, or you're terrified of something, and then suddenly everything just stops. And then, when you try to breathe in again, then you can't because it hurts so much…". (Case 9, 12 years)

TABLE 1 Participant background characteristics (*N* = 20)

	Number (%)
Age	
8–11	12 (60)
12–16	8 (40)
Gender	
Female	11 (55)
Male	9 (45)
Type of surgery	
Orthopaedic surgery	11 (55)
Ear/Nose/Throat surgery	3 (15)
Gastrointestinal surgery	5 (25)
Neurosurgery	1 (5)
Type of admission	
Elective surgery	10 (50)
Elective day surgery	6 (30)
Emergency surgery	4 (20)
Type of medication received	
Paracetamol	14 (70)
Cox-inhibitors (NSAIDs)	8 (40)
Opioid	11 (55)
Morphine infusion	1 (5)
Antiemetic	3 (15)
Midazolam (premedication)	7 (35)
Epidural anaesthesia	3 (15)
Neural blockade	1 (5)

TABLE 2 The children's reported worst pain intensity and pain location experienced in the recovery unit (*N* = 20)

	Number of children (%)
Pain intensity	
No pain (0)	3 (15)
Mild pain (1–3)	6 (30)
Moderate pain (4–6)	5 (25)
Severe pain (7–10)	5 (25)
Do not remember	1 (5)
Pain in surgical site	16 (80)
Unpleasant/painful elsewhere	10 (50)
Sore throat	4 (20)
Nausea/vomiting	6 (30)
Dizzy	5 (25)
Back pain	1 (5)
Pain in shoulder	1 (5)
Pain in neck	2 (10)
Pain in heels	1 (5)
Pain in mouth	1 (5)
Headache	2 (10)

Many of the children explained that it was painful to move and some experienced pain even when they were lying still in bed. One child who had undergone orthopaedic surgery explained:

> C: "When I tried to move it was like I couldn't get anywhere. I tried to move, but then it tightened so that I couldn't move anywhere." (Case 1, 13 years)

Another child described his experience:

> C: "It does hurt a little bit sometimes because I feel that I cannot find the correct position, but usually it goes pretty well when I achieve that position. It tightens a bit over the dressing and in my stomach."; R: "Hmm, that doesn't sound very good."; C: "No it wasn't, so therefore I could not straighten my back." (Case 15, 9 years)

4.1.2 | My feelings about pain

The children described their feelings about the pain experience using words such as disgusting, angry, scared, frightened, anxious, feeling down, depressed, upset and afraid. They reported being afraid of feeling pain and that pain scared them. One child was scared and cried when she felt pain when she breathed:

> R: "What did you do when it hurt to breathe?"; C: "I got very scared, and then I cried (...) And it was a really awful feeling." (Case 9, 12 years)

Another child explained why she was scared:

> R: "Did you get anything to drink down there then?", C: "I could, but I did not want to because I was a little bit scared, still"; R: "Yes. What were you afraid of?"; C: "Then I was a bit scared of – of what was going to happen, if something more would happen, that was even more painful and such." (Case 15, 9 years)

4.1.3 | Children's experiences with what felt unpleasant and painful aside from the surgical wound

Children described having pain associated with their surgical wound, but others reported pain in other places too (Table 2). The most commonly reported issues were dizziness, having a sore throat or nausea. Children reported having a hoarse or thin voice and coughing a lot. One child described:

> C: "I had a very sore throat, I remember. I had had something down my throat. So I coughed a lot, I remember." (Case 3, 14 years)

Some of the children said that nausea and vomiting were painful:

> C: "Of course it hurts an awful lot in your stomach when you throw up, because you sort of push on your stomach muscles...when you throw up and then you notice that it sort of really hurts a lot." (Case 9, 12 years)

Some of the children experienced nausea. Others were scared they might experience it. Some did not want to take pain medications or drink liquid because they were afraid of feeling sick and vomiting. One child said the following:

> C: "I haven't been feeling sick in any way, but I was very afraid I might be. Because, when I had a surgery when I was five, I had to throw up immediately after surgery. After that, I have been anxious about feeling sick or throwing up (...) Yes. That was the only thing I was afraid of. I wasn't afraid of the operation." (Case 3, 14 years)

Many children had received midazolam as a premedication. They talked about how it felt to not remember, to feel dizzy and to say funny things. Some described it as uncomfortable, strange or odd, and one reported it felt like she was drunk. One child said the following:

> C: "It made me...I was completely paralyzed in my mouth. I could not speak."; R: "Yes."; C: "I was sooo... and lots of mumbling (...) And then I do not remember anything from the (...) For those tablets."; R: "Yes mmm."; C: "They made me totally...totally forgetful... so I do not remember anything at all."; R: "How was it then?"; C: "It felt strange." (Case 2, 11 years)

Some children reported having experienced double vision. For example, they saw two moms or that their mom had two noses. One child said the following:

> C: "Mm I was dizzy, and eh...it hurt a bit in my arm (...) I had a headache, and I was seeing double of everything." (Case 9, 12 years)

Some children had unexpected pain in areas other than their surgery wound, including pain in their back, shoulder or neck, inside their mouth or heels (Table 2). One child explained the following:

> C: "Then I noticed that I had a kind of blister on the inside of my mouth (...) They told me it was because I had a tube in my throat that went into my mouth...that created these blisters." (Case 5, 16 years)

> C "I felt a bit of pain in my legs. So I moved them around a bit and...I had some pain in my heels. So, I just lifted my legs up a bit." (Case 5, 16 years)

4.2 | Children's experiences with pain management

4.2.1 | Why I didn't tell the nurse when I was in pain

Only five children remembered having used a pain assessment tool during their stay in the recovery unit. Some children told the nurses when they were in pain, while others did not. The children gave different explanations for why they did not tell the nurses about their pain. Some explained it was because the nurses had already asked them about their pain or they were waiting for the nurse to come and ask about it. Others waited to see if their pain got better or tried to endure it. Some believed the nurses could see when they were in pain:

> R: "But do you think that someone in a way can see if you are in pain?"; C: "Yes I believe so...they came by and looked at me and checked. They looked at my pain-infusion pump and on the monitor where they saw if I was in pain or not." (Case 1, 13 years)

Some children said they did not report their pain to the nurses because they did not want to have analgesic drugs. One child explained the following:

> R: "But have you told someone?"; C: "Um, sometimes. It is a bit difficult."; R: "Why is it difficult?"; C: "Because I didn't want to have some...have some medication or because...yes I become nauseous and I don't like that."; R: "So you did not really want the painkillers that they could give you?"; C: "No." (Case 15, 9 years)

4.2.2 | The medicines they gave me to help with my pain

Most of the children reported receiving pain medication from the nurses (Table 1) and that this helped with their pain. One child described the following:

> R: "What do the nurses do then?"; C: "They give you medicine and...if you are in pain they make sure that you are not in pain." (Case 4, 8 years)

The children described receiving pain medication in different ways. Some reported that it was difficult to swallow tablets:

> C: "I got painkillers, but I couldn't swallow it and then (...)"; R: "What did they do when you couldn't swallow

it?"; C: "They tried to split it."; R: "Yes, and was that better?"; C: "No."; R: "But did you get some other painkiller instead?" (shakes head). (Case 20, 12 years)

Some children spoke spontaneously about how unpleasant it was to receive a rectal suppository:

C: "The pills helped a little, the ones they stuck in my bum. But it was really uncomfortable! It hurt a little when they didn't get it in the right place and stuff like that, that's when I started going 'ow it hurts'." (Case 11, 9 years)

Some of the children had epidural anaesthesia or a neural blockade and described how it felt. Some were more prepared than others:

C: "Feels like my feet had fallen asleep (…)"; R: "What do you think would have helped you most when you were in pain? After the surgery?"; C: "Mm for example, before each time I was going to move, so I had a kind of button that I could press on, to get a little extra." (Case 5, 16 years)

Another said the following:

R: "Did you feel any pain when you woke up?"; C: "Nothing! I…they anesthetized the nerves from the knee and down. So I had…I was totally paralyzed, throughout from the knee down…until today around 12 o'clock. Then I began to move a little bit on my toes, and now I've got back ninety percent of the feeling. It hurts! (…)"; R: "Did you know about this before?"; C: "No, I wondered what it was." (Case 3, 14 years)

4.2.3 | Other things that helped me cope with my pain

The children described different nonpharmacological pain relief methods that were helpful. The children used positioning, relaxation and distraction most frequently. Some reported that changing their position helped, and some stated that they tried to lay still and not move to reduce their pain:

R: "It helps, to change positions?"; C: "Yes…mmm."; R: "Are there any other things that can help?"; C: "Yes…sometimes it may be okay to lie still." (Case 7, 13 years)

The children reported that relaxation was a useful method of pain relief; one described the following:

C: "…to relax and not to think too much about it and be in my own world (…) I close my eyes and think of something else…think of something that I like or someone that I love or something I like to do or such." (Case 9, 12 years)

Many children described thinking about something else, something they liked to do or someone they loved. The children reported using different distraction techniques once they were on the recovery ward. The methods they used included playing games on a mobile phone or tablet, watching films or YouTube or checking Instagram and Snapchat.

The children described the nurses using different nonpharmacological methods. Positioning, heat and cold were the most frequently used methods in the recovery unit. The children reported that the nurses helped them find a position that relieved their pain. One boy, who felt better when putting his operated foot on a pillow, said the following:

C: "They [nurses] put it [his foot] on a pillow (…) They do things so that it's not that painful anymore." (Case 16, 9 years)

Another child described her experience with receiving ice cubes after tonsillectomy:

R: "You know, we've talked about a lot of…uh, and the ice cubes and such?"; C: "That helped a little, but not a lot but it…it helped so that it got, it got a bit better in my throat. But not a huge lot, but it helped a little, I thought." (Case 11, 9 years)

Many children said that their parents could not do much to help them cope with their pain, because their parents did not know what to do. However, they gave examples that illustrated that having their parents there helped. The children reported that parents' use of emotional support and help with daily activity and positioning were the methods used most often:

R: "Was there anything they did then, which helped?"; C: "Yes…like…when I needed it, they gave me some water to drink, or massaged my feet or something like that."; R: "Yes. Mmm. And it also helped a little?"; C: "Yes." (Case 5, 16 years)

Not all methods helped. One child explained the following:

R: "Has your mom done something that has helped you?"; C: "She tried, but it didn't work."; R: "What did Mom try to do?"; C: "She tried to say that I had to breathe in and out very slowly." (Case 14, 9 years)

4.2.4 | What helped me feel safe and secure

The children spoke about feeling safe while their parents were together with them. They explained that this was because they did not want to be alone and their parents could get help for them or talk to them and explain what was happening. One child explained how it felt to have her mother there:

> C: "It was ok to have someone there…I didn't have to be alone (...) It feels safe." (Case 18, 16 years)

Some children also explained how they felt when their parents were not bedside when they awoke in the recovery unit:

> C: "I remember when I woke up and then I yelled at a nurse and said: 'Isn't it your job to ensure that Mom and Dad should be here now'…I did react that they weren't there when I woke up. I could see that all the others had their parents with them." (Case 3, 14 years)

The children also indicated that the nurses' presence helped them feel safe and secure. One child said the following:

> R: "What did the nurses do, did they do something more?"; C: "No, but they were there the whole time."; R: "Mmm, so you felt that they looked after you?"; C: "Yes (…)"; R: Do you remember if there were anyone else but Mom there?"; C: "It was a man…and many nurses there…I do not remember more."; R: "No, no, so you felt that it was…"; C: "Safe." (Case 12, 11 years)

4.3 | Children's recommendations for future pain management

The children's recommendations to nurses and other children were based on their own experiences and what they had found helpful when coping with their postoperative pain.

4.3.1 | Things I would have liked nurses to do to help me with my pain

The children's recommendations to nurses focused on providing more preparatory information, such as what was going to happen, that it would hurt after surgery, and to not drink too much after surgery because it might make you feel sick. One child said the following:

> C: "That it will hurt a bit after surgery." (Case 12, 11 years)

Another said the following:

> C: "Tell about the tube you put down our throat." (Case 1, 13 years)

They also wanted the nurses to be with them and talk to them, to give them pain medication when they needed it and to ensure that their parents are present when they awaken after surgery. One child said the following:

> C: "Give medicine when we need it." (Case 6, 11 years)

Another said the following:

> C: "I wish Mom and Dad were there when I woke up." (Case 3, 14 years)

4.3.2 | What children having surgery in the future need to know

The children also gave recommendations for other children who are going to have surgery. Their recommendations were about how they could distract themselves from the pain by thinking of something else, thinking of something nice or talking to someone:

> C: "Try to think of something else, not to think about that you are in pain or have a sore throat or something, try to do something else, so you forget, it helped me when I started reading a book. It got better." (Case 11, 9 years)

They also recommended staying calm, trying to sleep, taking medicine and not looking at the syringe. One child said the following:

> C: "Try to sleep." (Case 8, 9 years)

Another child said the following:

> C: "Do not look at the syringe—look at your dad instead." (Case 17, 9 years)

5 | DISCUSSION

More than half of the children in this study experienced moderate to severe pain during their time in the recovery unit. Many of them did not tell their nurses when they were in pain and pain assessment tools do not appear to have been used routinely. The children also experienced pain in places other than the surgical wound and reported that nausea and vomiting felt unpleasant and was sometimes worse than the pain itself. The children indicated that pain medications and nonpharmacological pain relief methods helped them cope with their pain. The children provided several recommendations for

nurses and for other children about how to improve postoperative pain management.

5.1 | Children's experiences with pain

The finding that children in our study experienced moderate to severe postoperative pain is consistent with other recent studies that used a retrospective chart review (Avian et al., 2016), a prospective chart review (Kozlowski et al., 2014) or interviewed parents and children (Birnie et al., 2014; Thienthong et al., 2014). It is noteworthy that the children in our study also described feeling unpleasant or pain in areas other than their surgical wound. Many children described having a sore throat, hoarseness, nausea, vomiting, headaches, dizziness, disorientation or impaired vision as unpleasant or painful. These are all common after anaesthesia and intubation (Falk, Fleisher, Jones, & Nussmeier, 2018).

A sore throat is the most common adverse event related to endotracheal intubation (Biro, Seifert, & Pasch, 2005; Hu et al., 2013; Jaensson, Olowsson, & Nilsson, 2010), yet very few of the children in this study reported being prepared for this. More than half the children in this study experienced postoperative nausea and vomiting (PONV), and described it as unpleasant or painful, has also been reported previously (Kozlowski et al., 2014; Rullander et al., 2013). In a study by Kozlowski et al. (2014), 44% of children experienced nausea and vomiting. PONV can increase pain (APA, 2016; Rullander et al., 2013) and prevent effective pain relief (Feinleib et al., 2018). Some children in this study did not tell the nurse when they were in pain because they were afraid of receiving pain medications that could cause nausea or vomiting. Even though almost half of these children experienced nausea and vomiting, only six were prescribed antiemetic medication and only three received this medication. Multimodal postoperative pain control strategies that reduce opioid administration should reduce the incidence of PONV (Feinleib et al., 2018), but less than half of the children received both paracetamol and an NSAID. PONV is a patient-important outcome and common side effect after anaesthesia, and it is important to identify risk factors relating to patient, anaesthetic and type and length of surgery (Feinleib et al., 2018). There is a need for healthcare professionals to be aware of children's anxiety about PONV, prevent and treat PONV.

Interestingly, our study shows that children complained about back pain in addition to pain in their neck or shoulder and sore heels (i.e., pain in places other than the surgical wound). This pain may be due to patient positioning and immobilisation during surgery. Immobilisation places patients at risk for skin and underlying tissue injury during anaesthesia and is well known for causing complications (Welch, Wahr, & Crowley, 2018). Optimal positioning during surgery and preventing injury and complications are responsibilities shared by the surgeon, anaesthetist and operating room nurses. Healthcare professionals should focus on these issues and prevent immobilisation complications.

Many of the children in this study reported experiencing dizziness and disorientation preoperatively, after receiving a premedication such as midazolam. They described having double vision, saying funny things and not remembering things, and that these were strange, odd and uncomfortable experiences. Lack of bodily control may feel scary and result in increased anxiety (Rullander et al., 2013), possibly preventing children from coping with the situation (Panella, 2016). There is a need to enhance the use of preparatory information, to focus on preventing complications after anaesthesia and to treat PONV.

5.2 | Children need to be prepared for surgery

Even though most of these children had elective surgery, we found they lacked preparatory information about pain (e.g., how much pain they would experience, where to expect pain, how long it would last), what would happen during their hospital stay, pharmacological management, and, for example, how it would feel after having a neural blockade. The children felt unprepared for their postoperative experience and said that they needed more information before the surgery. Many of the children experienced side effects after anaesthesia, and even the most common, such as sore throat and nausea, had not been explained to them. Some children asked for an explanation from their parents or a nurse, while others did not. For example, one child who had a sore throat and did not know why asked the nurse, who explained that it was because they had "put an air tube in your throat." Lack of preparatory information has also been reported in similar studies (Ford et al., 2012; Twycross & Finley, 2013). Insufficient preparatory information may lead to increased anxiety and pain (Fortier, Rosario, Martin, & Kain, 2010; Panella, 2016), which increases the risk of CPSP (Rabbitts et al., 2017).

Preparatory information about the operation itself, how much it will hurt afterwards and for how long, and what will be done to ease the pain are important and having this information benefits children (Lerman, Coté, & Steward, 2016). The information must be age-appropriate and repeated often to ensure that the child understands (Panella, 2016). Preparatory information may reduce anxiety and help children cope (Manyande, Cyna, Yip, Chooi, & Middleton, 2015). Additionally, children who are well prepared may not need premedication, such as midazolam, and may require less use of opioids postoperatively (Panella, 2016). Interventions such as videos and interactive games appear to be effective at reducing children's preoperative anxiety (Chow, Lieshout, Schmidt, Dobson, & Buckley, 2016; Manyande et al., 2015), and their use should be encouraged by nurses. Interestingly, one of the included hospitals has an evidence-based guideline on how to prepare children in different age groups for surgery. This guideline includes what to inform about, how to prepare them and how to use different preparatory videos, preparatory picture-books and hospital equipment. Apparently, not many nurses used this guideline to prepare the children for surgery. The children have rights to be consulted about the things that affect them and they need to be explained what is happening to them during the hospital stay (Regulation on Children's Stay in Hospitals, 2000). The nurses working in the recovery units should communicate with the children about their experience and explain why they

have pain in other places than the surgery wound, why they cannot move their leg because they have got neural blockade and so forth.

5.3 | Children do not always tell the nurses when they are in pain

One important finding from this study was that many of the children did not tell their nurses when they were in pain. Several explanations were given for this. Some children believed the nurses could see that they were in pain, others tried to wait and see if it got better, or they tried to endure the pain or to wait for the nurses to come and ask about their pain. Some children did not want pain medication because they were afraid of nausea or vomiting. This suggests that nausea and vomiting are considered as bad as or worse than pain, which concurs with the results of a previous study (Rullander et al., 2013).

Very few children in this study remember having their pain assessed with tools, which is consistent with previous studies (Birnie et al., 2014; Ford et al., 2012; Smyth et al., 2011; Twycross & Collis, 2013). This may be because pain assessment tools are unavailable on the unit (Smeland et al., 2018) or because nurses lack knowledge about how children of different ages express their pain and may expect that children will tell them when they are in pain (Rullander et al., 2013). It has also been demonstrated in other studies (von Baeyer et al., 2017; Pope et al., 2017) that children are able to verbally communicate about their pain intensity from around age 4–5 years. One strategy that helps nurses communicate with children about their pain is the use of valid, age-appropriate pain assessment tools (Hauer, Jones, Poplack, & Armsby, 2018).

If nurses do not use pain assessment tools or ask children about their pain intensity and location, they will not know where or how much pain the child is experiencing. This may mean that children experience unnecessary pain (Sng et al., 2013; Twycross & Finley, 2013). Strategies are needed to enhance nurses' pain assessment practices, by involving the children themselves and using appropriate tools to assess pain regularly. There is also a need to explore the reasons nurses do not routinely use pain assessment tools.

5.4 | What children think is helpful when they are in pain

The children reported that nonpharmacological pain relief methods were helpful for managing their pain. The children most frequently described nurses using nonpharmacological methods such as positioning, being present and applying heat and cold; they also pointed out that they needed more preparatory information. In this study, children identified their parents' presence as being crucial for feeling safe and secure and for helping them cope with their pain. Most, but not all parents were by their child's bedside when they woke up after surgery. The children pointed out that it was important to them that their parents were there when they awoke, because they helped the child by explaining what had happened, comforted them and helped them with daily activities. This concurs with the results of previous studies (He et al., 2007; Idvall, Holm, & Runeson, 2005; Polkki et al., 2003). Reasons for parents' late arrivals at the recovery unit included the following: not receiving the message to come to the recovery unit; nurses who were too busy in the ward to show the parents to the recovery unit; long distances between the ward and recovery unit; and that parents became lost on their way to the recovery unit. Another contributing factor might be the recovery nurses' attitudes about having parents present, despite the fact that nurses should encourage parents to be bedside in the recovery units and to remain with their child whenever feasible (Panella, 2016). Organisational barriers that prevent parents' presence in the recovery units need to be identified and addressed.

In this study, very few children commented on the environment, which is not in line with a study by Polkki et al. (2003), where children recommended that nurses create a more comfortable environment. This may be because nursing practices have changed since the earlier study, with greater focus now being placed on the use of nonpharmacological methods. Alternatively, the nurses in this study may have been particularly good at creating a comfortable environment. Twycross and Collis (2013) found that nurses seldom used nonpharmacological methods to reduce pain, which, again, differs from our results. Reasons for these differences may include that nurses working in recovery units are with the child almost all the time, whereas in the ward, the parents are with their children most of the time and the nurses are only there for short periods. This creates a situation where parents may carry out most of the nonpharmacological pain relief on the ward.

In this study, the children discussed nonpharmacological strategies that they thought were helpful. Other nonpharmacological strategies that may reduce pain were not mentioned, for example, guided imagery (Woragidpoonpol, Yenbut, Picheansathian, & Klunklin, 2013). Animal-assisted intervention may reduce distress for children undergoing painful procedures (Vagnoli et al., 2015), but was not in use in the hospitals in Norway at the time this study was carried out. Further research is needed to explore children's experiences about using these nonpharmacological strategies to relieve postoperative pain.

The children in our study indicated that it was difficult to swallow tablets and unpleasant to receive a rectal suppository. Despite there being many ways to administer pain medication, the children who could not swallow tablets were not offered an alternative. This is especially concerning in relation to young children who are usually unable to swallow tablets and may mean that they are not receiving adequate pain medications. This issue was exacerbated by the fact that many of these children had experienced, or were afraid of, nausea and vomiting. This made swallowing tablets even more difficult. Previous studies have reported that nurses lack the necessary knowledge about analgesics (Ekim & Ocakcı, 2013; Hovde, Granheim, Christophersen, & Dihle, 2012; Lunsford, 2015; Smeland et al., 2018), which may be one reason why children were not offered other options. Alternatively, the medication may not have been prescribed or available to administer via these routes. The children reported that both nonpharmacological and pharmacological pain

relief methods were helpful; they also challenged nurses to ensure that their parents are present when children awaken after surgery, provide more preparatory information and administer pain medications using more suitable methods.

5.5 | The nurses would make sure you are not in pain

In this study, some children reported that if they were in pain, the nurses would make sure their pain was treated, implying that if there was anything else to be done the nurses would do it. Rullander et al. (2013) found that parents lacked confidence in nurses' technical and treatment skills but that both parents and children rated their hospital experience as relatively satisfactory. The inconsistency between children experiencing moderate and severe pain while reporting being satisfied with their care replicates the results of another study (Twycross & Finley, 2013). This finding is of concern because if children expect to experience severe pain postoperatively and do not tell their nurses about it, this may contribute to ongoing undertreatment of children's pain. There is a need to encourage healthcare professionals to communicate with the children about their pain experience and to ensure them that their pain can be relieved.

Assessment and management of pain are essential to paediatric postoperative care (Anand, Gracia-Preats, & Kim, 2018; Hauer et al., 2018). Nurses, and other healthcare professionals, have a responsibility to ensure optimal postoperative pain management. This study suggests that current pain assessment and management practices are suboptimal and do not adhere to clinical guidelines in many areas. For example, few children were assessed as using pain assessment tools and half experienced PONV. Despite this, there was a belief among many of the children that their nurses would have relieved their pain if they had been able to do so. There is a need to prevent unnecessary suffering and to encourage nurses and other healthcare professionals to talk to their child patients and their parents about their expectations and pain management. Future research should explore why healthcare professionals do not communicate with children about the children's pain experience.

5.6 | Strengths and limitations

There were some limitations to this study. First, our participants were interviewed in the hospital —an unfamiliar setting—and had not previously met the interviewers. However, both interviewers had experience working with children and used a variety of strategies to gain the children's trust and build rapport before starting the interview. The interviewer assured the children that they could stop or take a break at any time during the interview. The children could also choose to have their parents present. Second, because the interviews were undertaken while the children were still in the hospital, this may mean the children provided favourable answers because of this. This may result in a positive response bias, especially if there was a perception that their answers might affect their care. However, the interviewers were not part of the nursing team and reassured the children before the interview that there were no right or wrong answers and assured that the care they received would not be influenced by whether or not they took part in the study.

Third, these children were 8–16 years old and underwent a range of surgical procedures; it is possible that this influenced individual responses. Nevertheless, exploring their breadth of pain experiences provides valuable information about children's experiences across these contexts. Fourth, the interviews were conducted at two hospitals within a relatively short time frame. To reduce information bias, the same two interviewers were present during all interviews: one interviewing and one observing. At the end of the interviews, the observer asked questions if something had been forgotten or was unclear, increasing the likelihood that areas identified in the interview guide were addressed. This study provides a useful insight into children's views about their pain management experiences in the recovery unit and identifies areas for further research and ways in which clinical practice can be improved.

6 | CONCLUSION

This study provides evidence that paediatric postoperative pain management remains suboptimal. Half of these children experienced moderate to severe postsurgical pain, few were assessed with a pain assessment tool, many received insufficient pain medication, and there was a lack of preparatory information provided. The children experienced pain associated with the surgical wound as well as pain in other locations. They explained why they did not always tell the nurses when they were in pain.

The children challenged nurses to use more nonpharmacological strategies, especially preparatory information, and to ensure parents are present when children awaken after surgery. Increased awareness among nurses about the importance of parental presence may prevent children from awakening alone, afraid and insecure. This study also shows that nurses alleviate postoperative pain by administering analgesics, although the children did not always receive medication appropriately (e.g., being given tablets when they could not swallow). The children in this study provided suggestions to nurses and to other children undergoing surgery on ways to improve postoperative pain relief and pain management.

7 | RELEVANCE TO CLINICAL PRACTICE

This study provides further evidence that children experience moderate to severe pain in the recovery unit after surgery and do not always tell their nurses when they are in pain. These results provide additional evidence that nurses appear not to use pain assessment tools routinely. In Norway, there are for the time being no national guidelines in paediatric postoperative pain management. Hospital policies and strategies are needed to enhance nurses' pain assessment practices, including involving the children themselves, using appropriate tools and assessing pain regularly. There

is also a need for establishing a child and youth advisory group at the hospitals to ensure children's rights and that Regulations on Children's Stay in Hospitals are met. Further studies exploring nurses' perspectives on children's rights versus paternalistic decision-making may contribute to a better understanding of nurses' choices of action. Children report that the use of nonpharmacological pain-relieving strategies helps them cope with pain. Given this, nurses should be encouraged to increase their use of nonpharmacological strategies, including preparatory information and education for children and their parents about postoperative pain management. Doing so will enhance paediatric pain management. Parents should always be at the child's bedside in the recovery unit when the child awakens postoperatively and should be encouraged to remain with their child whenever feasible.

PONV and other well-known postanaesthetic side effects can worsen children's pain at the very time when providing good pain relief is the priority and should thus be prevented or treated.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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SUPPORTING INFORMATION

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Original Article

Educational Intervention to Strengthen Pediatric Postoperative Pain Management: A Cluster Randomized Trial ☆

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ABSTRACT

Background: Pediatric postoperative pain is still undertreated.
Aims: To assess whether educational intervention increases nurses' knowledge and improves pediatric postoperative pain management.
Design: Cluster randomized controlled trial with three measurement points (baseline T1, 1 month after intervention T2, and 6 months after intervention T3).
Participants/Subjects: The study was conducted in postanesthesia care units at six hospitals in Norway. Nurses working with children in the included units and children who were undergoing surgery were invited to participate in this study.
Methods: Nurses were cluster randomized by units to an intervention (n = 129) or a control group (n = 129). This allocation was blinded for participants at baseline. Data were collected using "The Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain: Norwegian Version" (primary outcome), observations of nurses' clinical practice, and interviews with children. The intervention included an educational day, clinical supervision, and reminders.
Results: At baseline 193 nurses completed the survey (75% response rate), 143 responded at T2, and 107 at T3. Observations of nurses' (n = 138) clinical practice included 588 children, and 38 children were interviewed. The knowledge level increased from T1 to T3 in both groups, but there was no statistically significant difference between the groups. In the intervention group, there was an improvement between T1 and T2 in the total PNKAS-N score (70% vs. 83%), observed increase use of pain assessment tools (17% vs. 39%), and children experienced less moderate-to-severe pain.
Conclusions: No significant difference was observed between the groups after intervention, but a positive change in knowledge and practice was revealed in both groups. Additional studies are needed to explore the most potent variables to strengthen pediatric postoperative pain management.

Many children undergo surgery daily. Postoperative pain management is crucial in postoperative care, and nurses working in postanesthesia care units have an essential role to ensure optimal postoperative pain management. Despite extensive research, postoperative pain in children continues to be underestimated and undertreated (Ostojic et al., 2019; Sng et al., 2017; Twycross et al., 2015). Children still experience moderate to severe pain after surgery (Avian et al., 2016; Ocay et al., 2020). Undertreated pain after surgery causes unnecessary suffering (Avian et al., 2016), and increases the risk of complications (Schoenfeld et al., 2017; Schwaller & Fitzgerald, 2014) and longer hospital stays (Martin et al., 2020). Consequences of inadequate postoperative pain relief are reported to be increased risk of developing chronic postsurgical pain in 20% of the children (Rabbitts et al., 2017).

There are reported many barriers to effective pediatric pain management, such as health care professionals' misconcep-

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tions and their lack of knowledge about pain management (Alotaibi et al., 2018; Bouri et al., 2018; Peirce et al., 2018; Peng et al., 2020; Wuni et al., 2020), fears of adverse effects of opioids (Czarnecki et al., 2019; Peng et al., 2020; Whitley et al., 2020), insufficient premedication (Czarnecki et al., 2019), lack of local policies/guidelines (Bouri et al., 2018), insufficient or inadequate prescribed medication (Czarnecki et al., 2019; Tomaszek & Debska, 2018), inadequate or inconsistent use of pain assessment tools (Kusi Amponsah et al., 2020b; Whitley et al., 2020; Wuni et al., 2020), inadequate staffing (Kusi Amponsah et al., 2020b; Wuni et al., 2020), complexity of the clinical environment (Bouri et al., 2018), lack of clinical experience and training (Bouri et al., 2018; Kusi Amponsah et al., 2020b; Mediani et al., 2017; Whitley et al., 2020), inadequate education (Peng et al., 2020; Whitley et al., 2020), and lack of an interdisciplinary team for relieving pain (Peng et al., 2020). All these barriers are important to acknowledge to improve pain management in children. However, changing how health care is delivered is difficult (Braithwaite, 2018). Keys to changing clinical practice is acting scientifically, embracing complexity, engaging and empowering (Reed et al., 2018), and identifying barriers and facilitators to effective pediatric pain management (Stocki et al., 2018). Implementation strategies need to be multifaceted and multileveled and selected and tailored to address the identified barriers (Powell et al., 2017; Powell et al., 2019; Stevens et al., 2014).

The effectiveness of educational interventions on nurses' pediatric pain management knowledge has been examined using questionnaires (Dongara et al., 2017; Huth et al., 2010; Mousa, 2019) or combining questionnaires and chart reviews (Ellis et al., 2007; Heinrich et al., 2016; Johnston et al., 2007; Kingsnorth et al., 2015; Le May et al., 2009; Lunsford, 2015; Rosenberg et al., 2016; Vincent et al., 2011). In these 11 studies mentioned above the educational intervention focus on pediatric pain management basic principles (8 studies), pain assessment (9 studies), pharmacological pain management (10 studies), and nonpharmacological pain management (9 studies). The format of knowledge translation (KT) used in these studies included in-service/workshop (Dongara et al., 2017; Ellis et al., 2007; Huth et al., 2010; Johnston et al., 2007; Le May et al., 2009; Vincent et al., 2011), conference (Lunsford, 2015) or internet-based educational intervention relieving children's pain on an Internet site (Vincent et al., 2011), with use of informal training/bedside training/coaching (Ellis et al., 2007; Johnston et al., 2007), simulations/role-play (Huth et al., 2010; Vincent et al., 2011), change champions (Ellis et al., 2007), handouts/resource materials (Ellis et al., 2007; Johnston et al., 2007; Le et al., 2009), audits (Johnston et al., 2007), and pain assessment tools (Ellis et al., 2007; Le May et al., 2009). The interventions lasted from 1-4 hours (Dongara et al., 2017; Ellis et al., 2007; Huth et al., 2010; Kingsnorth et al., 2015; Le May et al., 2009; Lunsford, 2015; Vincent et al., 2011) or for 2 days (Johnston et al., 2007). Results from these studies showed nurses' perceived improvement in their own pain practice regarding pain assessment and management (Ellis et al., 2007), most (7 out of 10 studies) found improved knowledge of pain management (Dongara et al., 2017; Huth et al., 2010; Kingsnorth et al., 2015; Le May et al., 2009; Lunsford, 2015; Mousa, 2019; Rosenberg et al., 2016), three of four found increased use of pain assessment tools (Ellis et al., 2007; Johnston et al., 2007; Le May et al., 2009), two of three found increased use of nonpharmacological pain techniques (Johnston et al., 2007; Le May et al., 2009); however, only one of four studies found increased use of analgesics after an educational intervention (Heinrich et al., 2016). Vincent et al. (2011) conducted a pilot intervention study, based on Kolb's learning modes in relieving children's pain (concrete experience, reflective observation, abstract conceptualization, and active experimentation), showing improvement in nurses' pain beliefs and documented pain management.

There are several studies aiming to improve pediatric postoperative pain management in the literature; however, many studies are based on small samples (Dongara et al., 2017; Heinrich et al., 2016; Huth et al., 2010; Kingsnorth et al., 2015; Le May et al., 2009; Vincent et al., 2011), and only Johnston et al. (2007) had a control group. Moreover, none of these studies measured whether a tailored educational intervention improved nurses' pediatric postoperative pain management clinical practice by also observing the nurses and exploring the children's experience of pain and pain management by interviewing them. Observations of postoperative pain management clinical practice are of importance to document what nurses actually do. Furthermore, it is important to interview children to explore how they experience postoperative pain management, what pain relieving techniques that were helpful, and their suggestions for improvements.

Aim

The aim of the present study was to assess whether a tailored educational intervention for nurses working in Norwegian postanesthesia care units (PACUs) increased their knowledge and attitudes regarding pediatric pain management and improved actual postoperative pain management in an intervention group compared to a control group.

Methods

The present study is registered at ClinicalTrials.gov (ClinicalTrials.gov Identifier: NCT03385681). The CONSORT 2010 guidelines for reporting a cluster randomized trial and the Template for Intervention Description and Replication checklist and Consolidated criteria for reporting qualitative studies (COREQ): 32-items checklist were followed. Approvals were obtained from the hospitals' Social Science Data Services, Regional Committee for Medical Research Ethics (no. 399805) and from all the included hospitals. Data were collected from September 2014 to October 2015.

Design

A cluster randomized controlled design was used with three measurement points: baseline (T1), 1 month (T2), and 6 months (T3) after the intervention, using different methodological approaches (survey for nurses, observational study of nurses' clinical practice, and interviews with children). Participants were cluster randomized by units to an intervention or to a control group.

Participants and Setting

In Norway there are six university hospitals, covering all health regions. The largest PACU in each of these six university hospitals were included. Five of these units cared for both children and adults. There were 30-60 nurses who worked with children in each unit and about 5-15 children undergoing surgery daily.

All nurses working with children in the PACUs were invited to complete the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain Questionnaire–Norwegian Version (PNKAS–N). Nurses not involved in clinical work or working part-time (<.75 whole time equivalent) were excluded. In addition, were nurses in the included units observed in clinical practice (when providing postoperative care to children admitted to these units) if they

were on duty during the observational periods. Lastly, children (6-18 years) who were undergoing surgery at two hospitals, with their parents, were invited to participate in interviews. Children with cognitive impairments who were unable to communicate verbally, those who did not speak Norwegian, and those who were admitted to the intensive care unit after surgery, were excluded from the interviews.

Randomization

The participants were cluster randomized by units to either an intervention or a control group. Three units were randomly chosen to be in the intervention group and three in the control group. This allocation was blinded for the participants (children and parents) at all measurement points and for the health care professionals at baseline.

Tailored Educational Intervention

A tailored educational intervention was developed using a consolidated framework for implementing research (Damschroder et al., 2009) consisting of five domains (the intervention, inner and outer setting, the individuals involved and the process by which implementation is accomplished), and included KT strategies (e.g., audit and feedback, educational outreach, coaching, educational materials, and reminders) to promote nurses' use of research evidence to enhance practice and improve clinical outcomes (Stevens et al., 2014). Barriers to effective pediatric postoperative pain management were identified from the baseline data and addressed as part of the intervention. The tailored intervention aimed to target barriers on different levels (e.g., hospital-related, unit, and health care professionals-related). The details of the intervention are described in Figure 1. In short, the intervention included an educational day (lectures and workshops), clinical supervision, reminders, and provision of pain assessment tools and equipment required to implement age-appropriate nonpharmacological pain-relieving strategies.

The educational day focused on the lack of knowledge and skills regarding pediatric postoperative pain management identified at baseline in each unit. General pain management, pain assessment strategies for children of all ages, and the pharmacological and nonpharmacological pain-relieving strategies that can be used with children were covered. One-to-one clinical supervision was offered to nurses in pediatric pain assessment and postoperative pain management (pharmacological and nonpharmacological), 3-6 days per unit depending of the size of the unit. The intervention was conducted by experts (nurses and physician) in pediatric postoperative pain management. Different reminders of evidence-based pain management were also provided (posters, pamphlets, newsletters, focus weeks, etc.) following the educational day (additional details are shown in Fig. 1 and Supplement B and C).

Data Collection

Data were collected using survey to measure nurses' knowledge and attitudes regarding pediatric pain (primary outcome), observations about nurses' pediatric pain management practices, and interviews with children about their experiences of pain and postoperative pain management (secondary outcomes).

Data were collected from all six units using the "The Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain: Norwegian Version" (PNKAS-N, primary outcome) at all three measurement points (T1, T2, and T3). Observational data were collected in all six units at baseline (T1), and four units at T2, and two units at T3 randomly chosen. Interviews with children were carried out in one unit from the intervention group and one unit from the control group, chosen randomly, at both T1 and T2 (the same units). The flow chart is depicted in Figure 2.

Primary Outcome

Questionnaire about nurses' knowledge and attitudes regarding pediatric pain

Data relating to nurses' knowledge and attitudes regarding pediatric pain were collected using PNKAS-N. The PNKAS was developed by Manworren (2000), revised in 2002 (Rieman et al., 2007) shows satisfactory psychometric properties in Norwegian samples (Hovde et al., 2012). In the present study the Cronbach's alpha was .76 for the total PNKAS-N. The PNKAS-N consists of 40 items, covering general pediatric pain management, pain assessment, and pharmacological and nonpharmacological pain management. In addition, data were collected about nurses' age, educational level, working experience, use of pain assessment tools, and whether the hospitals or units had guidelines for pediatric pain assessment and pediatric pain management.

Secondary Outcomes

Observations of the nurses' clinical practice

Nonparticipant observation with a structured observational tool (checklist) and field notes were used to collect data regarding the nurses' postoperative pain management clinical practice. The checklist was based on the work done by Twycross et al. (2013), and postoperative pain management guidelines (APA, 2012), and included the same areas as in the PNKAS-N. The focus was on observing nurses' assessment of children's pain as well as the pharmacological (given before, during, and after surgery in PACUs) and nonpharmacological pain-relieving strategies used in the PACUs. The field notes were situational and included descriptions of what happened in the PACUs relating to postoperative pain management. In addition, the observed children's weight, age, and type of surgery were collected. The checklist was pilot tested. Following test, some small amendments were made to the structure of the checklist to focus on the child rather than the nurse. This provided a better picture of pain management practices because some children were cared for by more than one nurse during an observational period.

Interviews with children

Data regarding children's experiences of pain and postoperative pain management in the PACUs were collected using semi-structured face-to-face interviews. Details about the interviews at baseline are described earlier (Smeland et al. 2019). Two different interview guides were developed (6-11 years and 12-18 years). The semi-structured interview guides were based on the work done by Polkki et al. (2003) and best practice guideline (APA, 2012) and focused on children's pain experience, pain assessment and pain management (pharmacological and nonpharmacological). Data on the children's age, gender, type of surgery, and type of admission were also collected.

Procedure

Before the study started, the first author established a dialogue with the stakeholders at all the included hospitals, met with them (unit leader team: nurse leaders, physician and educator, and research directors at the hospitals) to discuss the project with them, to involve and engage them in the project plan, and to get permission to conduct the study. After developing a detailed plan for data sampling at each hospital and receiving all the permissions from

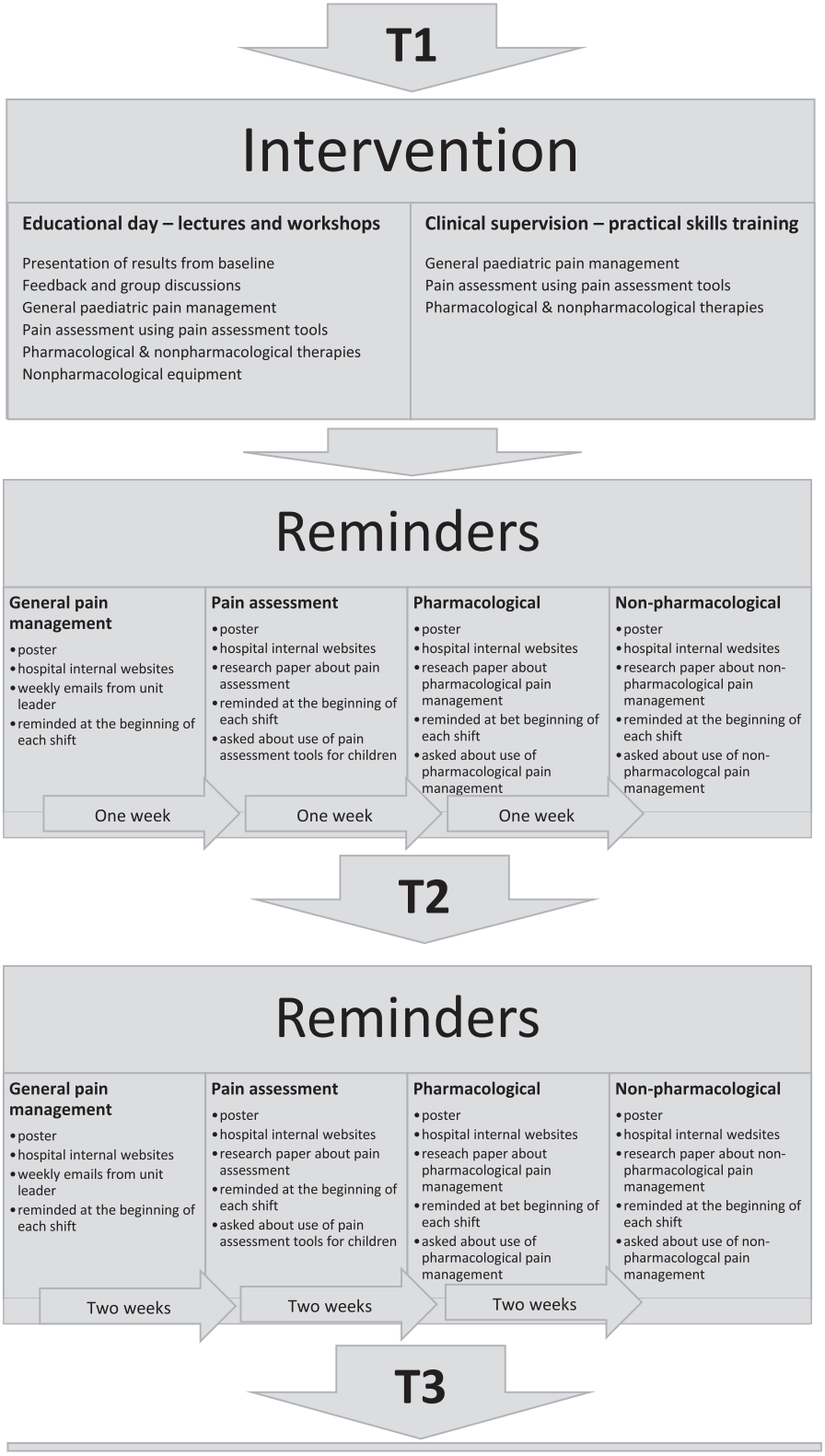

Figure 1. The tailored educational intervention package.

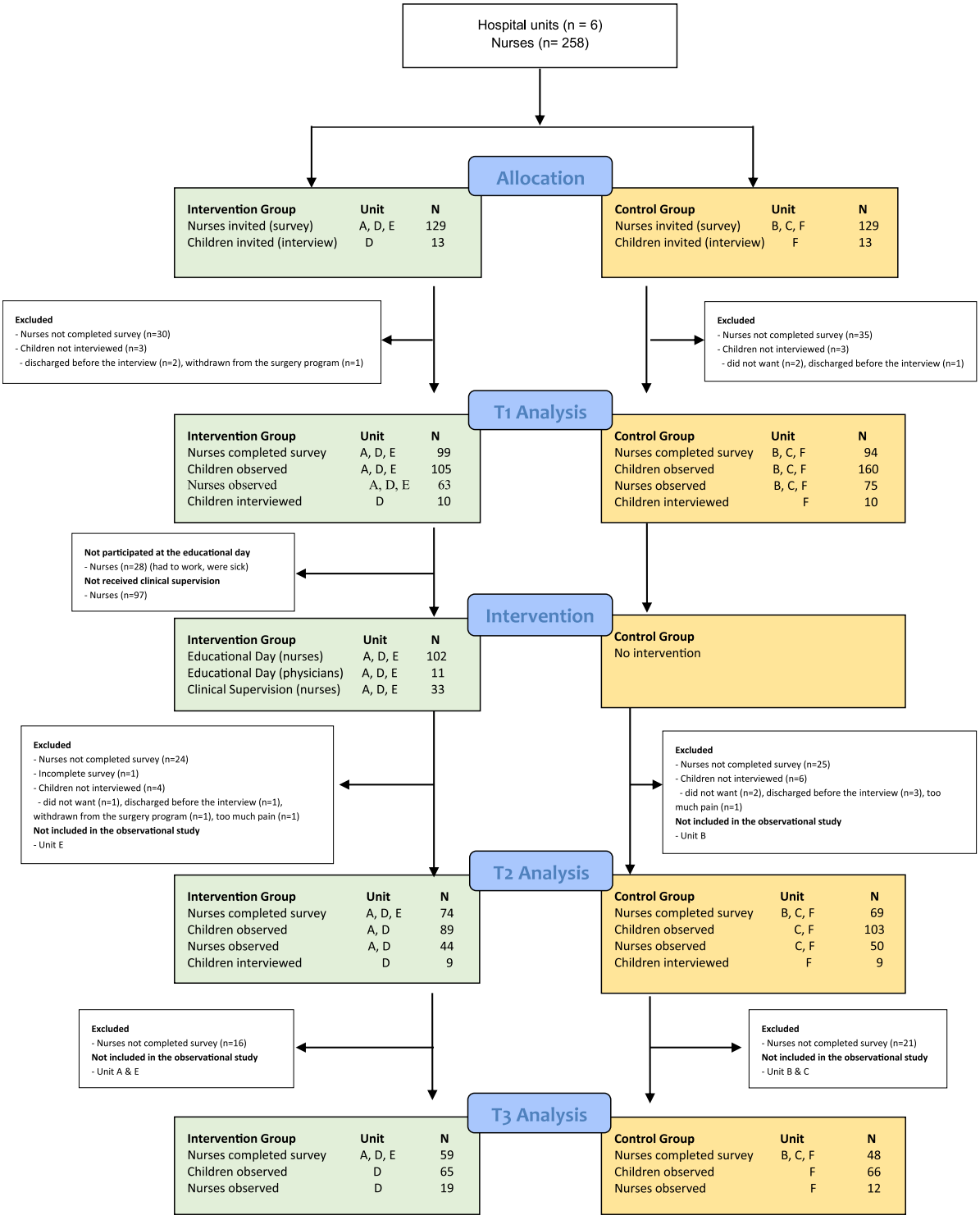

Figure 2. CONSORT flow diagram.

the hospitals (including local Social Science Data Services) and Regional Committee for Medical Research Ethics, the study started.

The PNKAS-N was distributed to all the nurses working with children (258 nurses), across all six sites, with an information letter and an envelope for returning the survey. Participants also received verbal information about the study. Written informed consent was obtained from the nurses who completed the survey.

Concurrently, nurses were observed in clinical practice using nonparticipant observation. Informed consent was obtained from all participants (nurses, children, and their parents) for the observational data collection. The same researcher undertook all the observations and sat in a corner of the room without disrupting the nursing care. During each data collection period, observations were carried out for 4-6 hour periods, for 2 weeks per unit.

During the same period, interviews with children undergoing surgery were conducted. The nurses on the surgical wards identified children who met the inclusion criteria and asked them and their parents if they were interested in information about the study. Three different information letters were used (6-11 years, 12-18 years, and parents). Informed consent was obtained from all children and their parents, and written informed consent was obtained from all parents and from children aged 12 years and older. Additional details can be seen in the COREQ (Supplement D).

Methods of Data Analysis

Sample Size Calculation

The sample size was estimated for the primary outcome, PNKAS-N. A difference between the groups of two points with a standard deviation (SD) of four using the PNKAS-N mean score was considered to be clinically relevant. Given a statistical power of 80% and significance level of 5% (two-sided test), a total of 128 participants (64 in each group) was required. Taking into consideration at least a 25% attrition rate at T2 and accounting for additional 10% for cluster randomization, all nurses working with children at the six selected units (n = 258) were invited to participate to ensure that this study was sufficiently powered.

Primary Outcome

Questionnaire about nurses' knowledge and attitudes regarding pediatric pain

Continuous data were described with mean and standard deviation (SD), when normally distributed, or with median and range (for skewed data). Categorical data were presented as counts and percentages. Crude comparisons between groups regarding continuous variables that were not normally distributed were performed using Mann-Whitney *U* tests. Regarding the primary outcome (PNKAS-N) possible differences between the intervention and control group over the whole follow-up and at given time points were estimated using linear mixed models for repeated measures. The models were adjusted for possible confounders (baseline differences concerning age and working experience). The results are presented as point estimates with 95% confidence intervals (CI). All tests were 2-sided. *P* values $< .05$ were considered statistically significant. All analyses were considered exploratory so no correction for multiple testing was made. All analyses were conducted using IBM SPSS Statistics for Windows (version 24-26) and performed according to intention-to-treat principles.

Secondary Outcomes

Observations of the nurses' clinical practice

Frequency counts, percentages and CIs were calculated for categorical data from the observational data checklist. All analyses were conducted using IBM SPSS Statistics for Windows.

Interviews with children

Children's responses to the interview questions were transcribed verbatim by the researchers and structured using NVivo (QSR NVivo Pro for Windows, version 11-12). Content analysis was used to analyze the transcripts by researchers using a six-step approach (Creswell, 2014).

The analysis is described in more depth in Smeland et al. (2019) and in COREQ (Supplement D). The main results are presented in this article.

Results

A total of 193 nurses completed the PNKAS-N questionnaire at baseline (75% response rate), 143 at T2, and 107 at T3. In the intervention group, 79% (102/129) of the nurses participated on an educational day and 26% received clinical supervision (Fig. 2). During the study, 45%-53% of the nurses, depending on the measurement point, were observed providing postoperative care to 588 children (observational time each child, mean 114 minutes, SD 63 minutes) at selected units (two weeks per unit per measurement points and 805 hours all together). Furthermore, 54 children met the inclusion criteria for interviewing and 38 were included (Fig. 2).

Background Characteristics of the Different Samples

Background characteristics of the nurses

The nurses' median age was 42 years (range, 23-63 years) and more than half (56%) were specialized in intensive care. Educational level was similar for nurses who responded and those who did not. The nurses responding to the follow-ups had significantly longer work experience as a nurse ($p = .008$) than the nurses who dropped out during the study, but there were no statistically significant differences in age, working experience in current ward, or educational level between the respondence and drop-outs at T2. In the intervention group, nurses were significantly older ($p = .011$) and had longer work experience as a nurse ($p = .005$) than in the control group (Table 1). There were some differences between each unit within each cluster; however, nurses in all included units were experienced (median age ≥35 years, median work experience as a nurse ≥12 years, median work experience in current ward ≥2 years).

Background characteristics of the children observed

Observational data were collected at each PACU and included observing 138 nurses (53%) giving postoperative care to 265 children at baseline (all units), 192 children at T2 (four units, 68% of the nurses), and 131 children at T3 (two units, 51% of the nurses). Almost half of the children were under five years of age (28 children were <1 year old), and the main surgery groups were ear, nose, and throat surgery and orthopedic surgery (Table 2).

Background characteristics of the children interviewed

The interviews were carried out on two of the PACUs and included 20 children (aged 8-16 years) at baseline and 18 children (aged 9-17 years) at T2. Half of the children had undergone elective surgery, and the most common type of surgery was orthopedic surgery (47%).

Primary Outcome

Baseline Level of Knowledge

The total PNKAS-N mean score for the intervention group was 27.8 (69.5% correct answers) (SD 4.0) and 30.1 (75.3%; SD 4.2) in the control group at baseline. Knowledge deficits were identified in both groups, most often regarding pharmacological pain management. The results of the PNKAS-N survey at baseline are described in more depth for the total sample in Smeland et al. (2018).

Differences between and within the groups over time in total PNKAS-N score

When adjusted for baseline differences (nurses' age and work experience as a nurse) both groups improved in the total PNKAS-

Table 1
Background Characteristics of the Nurses in the Intervention and Control Groups (N = 193)

Characteristics	Intervention Group Median (Range) n = 99	Control Group Median (Range) n = 94	*p*
Age (y) (n = 186)	44 (23–63)	40 (24–62)	.011
Work experience as a nurse (y) (n = 193)	17 (3-40)	14 (2-40)	.005
Work experience in current ward (y) (n = 174)	5 (0-32)	5 (0-18)	.111
	n (%)	n (%)	
Educational level (n = 193)			
Bachelor	31 (31)	35 (37)	.387
Specialist nurse[a]	68 (69)	59 (63)	
Nursing specialty (n = 127)			
Critical care nurse	64 (65)	44 (47)	
Pediatric nurse	1 (1)	15 (16)	
Other specialist nurses	3 (3)		

[a] To become a specialist nurse (critical care or pediatric) in Norway requires the completion of an additional 1.5 years' education program after a bachelor's degree in nursing (a 3-year, full-time degree) at a university college or a university in Norway.

Table 2
Background Characteristics of the Children Observed at the Different Measurement Times in the Intervention and Control Groups (N = 588)

Characteristics	Intervention Group n (%)			Control Group n (%)		
	T1 n = 105	T2 n = 89	T3 n = 65	T1 n = 160	T2 n = 103	T3 n = 66
Age (y)						
)	42 (40)	37 (42)	36 (55)	65 (41)	52 (50)	32 (48)
0-5	25 (24)	26 (30)	14 (22)	46 (28)	31 (31)	17 (26)
6-11	37 (35)	26 (29)	15 (23)	49 (31)	20 (19)	17 (26)
12-18	1 (1)					
Unknown/missing						
Type of surgery						
	17 (16)	12 (14)	3 (5)	54 (34)	36 (35)	19 (29)
Gastrointestinal	26 (25)	21 (24)	15 (23)	42 (26)	24 (23)	11 (17)
Orthopedic	43 (41)	47 (53)	43 (66)	16 (10)	9 (9)	4 (6)
Ear/nose/throat	19 (18)	9 (10)	4 (6)	48 (30)	34 (33)	32 (48)
Others						

T1 = baseline; T2 = 1 month after the intervention; T3 = 6 months after the intervention.

Table 3
Mean PNKAS-N Score at the Different Measurement Times in the Intervention and Control Groups

Time	No.	Control Group Mean [95% CI]	No.	Intervention Group Mean [95% CI]
T1	94	30.1 [29.2-31.0]	99	27.8 [27.0-28.7]
T2	69	31.7 [30.7-32.8]	74	33.0 [32.0-34.0]*
T3	48	32.7 [31.5-33.9]*	59	32.7 [31.5-33.8]*

T1 = baseline; T2 = 1 month after the intervention; T3 = 6 months after the intervention.
Multiple linear regression was applied for repeated measures adjusted for age and work experience as a nurse.
*Statistically significant within group differences, $p < .05$

N score over time ($p < .001$), but no overall statistically significant differences in change were revealed between the two groups ($p = .426$; Table 3). However, the differences in the total PNKAS-N mean score between the two groups were more than two points (four at T2 and five at T3), which we considered as clinically relevant. Statistically significant improvement in the total PNKAS-N mean score was revealed in the intervention group between baseline and T2 (27.8; 95% confidence interval [CI], 27.0-28.7 vs. 33.0; 95% CI, 32.0-34.0). The improvement was sustained at T3 (32.7; 95% CI, 31.5-33.8). In the control group, no significant improvement in total PNKAS-N mean score was revealed between baseline and T2 (30.1; 95% CI, 29.2-31.0 vs. 31.7; 95% CI, 30.7-32.8); however, there was significant improvement between T1 and T3 (30.1; 95% CI, 29.2-31.0 vs. 32.7; 95% CI, 31.5-33-9).

Between groups differences for the individual PNKAS-N items

When analyzing the individual PNKAS-N items, statistically significant improvement was revealed between baseline and T3 in 75% (30/40) of the items in the intervention group and in 15% of the analyzed items (6/40) in the control group. Improvement was revealed in 7 out of 8 of the general pain management items, 5 out of 6 of the pain assessment items, 13 out of 21 of the pharmacological items, and all five items of the nonpharmacological items in the intervention group. In contrast, in the control group, an improvement was revealed in 2 out of 8 of the general pain management items, none of the pain assessment items, 3 out of 21 of the pharmacological items, and 1 out of 5 of the nonpharmacological items.

The nurses' self-reported use of pain assessment tools increased significantly between baseline and T3 (74%; 95% CI, 65–83% vs. 95%; 95% CI, 89%-100%) in the intervention group, especially the reported use of the Face, Legs, Activity, Cry, Consolability scale (6%, 95%, CI 1%-11% vs. 71%, 95% CI, 59%-83%). In the control group, there were no statistically significant changes between baseline and T3 in the nurses' self-reported use of pain assessment tools (96%; 95% CI, 92%-100% vs. 95%; 96% CI, 90-%100%).

Table 4
Use of Pain Assessment Tool at the Different Measurement Times in the Intervention and Control Groups (N = 588)

	Intervention Group n (%) or [95% CI]			Control Group n (%) or [95% CI]		
	T1 n = 105	T2 n = 89	T3 n = 65	T1 n = 160	T2 n = 103	T3 n = 66
Face, legs, activity, cry, consolability scale (FLACC)b	2/41 (5) [−2 to 12]	16/44 (36)[a] [22-51]	11/38 (29)[a] [14-44]	5/60 (8) [1-16]	6/50 (12) [3-21]	1/32 (3) [−3 to 9]
Faces Pain Scale–Revised (FPS–R)b	2/9 (22)	3/12 (25)	3/10 (30)	4/17 (24)	5/15 (33)	1/5 (20)
Colour Analogue Scale (CAS)b	[−12 to 56]	[−4 to 54]	[−5 to 65]	[1-46]	[6-60]	[−36 to 76]
Numerical Rating Scale (NRS)b	10/50 (20)	13/33 (39)	9/16 (56)	21/70 (30)	7/30 (23)	10/26 (38)
Visual Analogue Scale (VAS)b	[9-31]	[22-57]	[29-84]	[19-41]	[7–39]	[18-59]
Revised, face, legs, activity, cry, consolability scale (r-FLACC)b	0/4		0/1	0/13	0/8	0/3
Incorrect tool	4/105 (4) [0-8]	3/89 (3) [−1 to 7]	2/65 (3) [−1 to 7]	3/160 (2) [0-4]	3/103 (3) [0-6]	1/66 (2) [−1 to 5]
Total	18/105 (17) [10-24]	35/89 (39)[a] [29-49]	25/65 (38)[a] [26-51]	33/160 (21) [14-27]	21/103 (20) [12-28]	13/66 (20) [10-30]

CI = confidence interval; T1 = baseline; T2 = 1 month after the intervention; T3 = 6 months after the intervention.
[a]Statistically significant, $p < .05$
[b]Different pain assessment tools used are expressed as percentage of the correct use.

Secondary Outcomes

Changes in nurses' pediatric pain management practices after the intervention (observational data)

The results from baseline, as assessed by observation, revealed that few children were assessed with a pain assessment tool, children received inadequate administration of acetaminophen and low doses of morphine postoperatively and only 26% received COX inhibitor (nonsteroidal anti-inflammatory drug [NSAID]). Nurses often used nonpharmacological pain-relieving techniques, but seldom nonpharmacological pain-relieving techniques such as thermal regulation or positioning. The baseline results are described more in depth in Smeland et al. (2018).

Pain assessment

At baseline, 18 children (17%) were assessed with a valid pain assessment tool in the intervention group and 33 children (21%) in the control group, and few units had pain assessment tools available. After the intervention, all nurses in the intervention group had their own pain assessment tools. Statistically significant improvement was revealed regarding the use of pain assessment tools between baseline and T2 (17% vs. 39%) in the intervention group, and the improvement was sustained at T3 (17% vs. 38%). Furthermore, for children aged 5 years or under in the intervention group, statistically significant increased use of pain assessment tools was revealed between baseline and T2 (5% vs 36%), and the improvement was sustained at T3 (5% vs. 29%). In the control group, no statistically significant improvement was revealed between T1, T2, and T3 (Table 4).

Pharmacological pain management

At baseline, 88% of the children in the intervention group received acetaminophen (paracetamol) and 30% received a COX inhibitor (NSAID) at baseline (Table 5). Furthermore, 28% of the children received an intravenous (IV) opioid postoperatively, and 83% of those who received opioids (morphine or ketobemidone) were given doses less than 0.05 mg/kg. None of the units had evidence-based guidelines regarding pediatric postoperative pain management. After intervention, the units in the intervention group worked with developing local guidelines, but they were not finished/published at T3. Increased use of COX inhibitors (30% vs. 43%), opioid (34% vs. 40%), and adequate doses of morphine or ketobemidone (17% vs. 46%) were revealed between T1 and T3 in the intervention group but did not reach the level of statistical significance. However, statistically significant improvement was revealed regarding use of IV acetaminophen between T1 and T3 (28% vs. 73%) in the intervention group. In the control group, no statistical improvement was revealed between T1 and T3 regarding use of COX inhibitors and adequate doses of opioid (Table 5).

Nonpharmacological pain management

At baseline, nonpharmacological pain-relieving strategies were frequently used in both groups, for example, emotional support and cognitive/behavioral methods (e.g., preparatory information and distraction), but physical methods such as thermal regulation (heat and cold) or positioning were used less frequently. After intervention, all units in the intervention group had age-appropriate nonpharmacological pain-relieving equipment (e.g., toys, soap bubbles, books, DVD player, and DVDs). In the intervention group, a significantly increased use was revealed between T1 and T3 regarding preparatory information (61% vs. 82%), and comforting/reassurance (43% vs. 71%). In the control group, a significantly increased use of distraction (49% vs. 73%) was revealed between T1 and T3 (Table 5).

Children's experiences of pain and pain management (interviews)

The results from the interviews with children at baseline have been described in-depth in Smeland et al. (2019). In short, three themes emerged from the interviews at baseline. Children's experiences of what felt unpleasant and painful, children's experiences with pain management and children's recommendations for future pain management. Half of the children experienced moderate (4-6 out of a score of 10) to severe pain (7-10) while in the PACU. Many children did not tell the nurse when they had pain if not asked, and only a few were assessed with a pain assessment tool. The children reported that nausea and vomiting felt unpleasant and painful, and experienced pain in other places than the surgical wound, too. They experienced difficulties in swallowing tablets and felt unpleasant when receiving a rectal suppository.

Three themes emerged from the interviews with children in the intervention group at T2: waiting time before surgery, children's pain experiences, and what children experienced were helpful in relieving pain. The children experienced the waiting time before surgery differently. Some were scared and anxious about the surgery; others were looking forward to having their problems fixed or having less pain after surgery. All children wanted the waiting time to be short. The children also experienced pain in other places than the surgery wound (e.g., headache, shoulder, sore throat) and a few were nauseous. The children reported that medication and nonpharmacological pain-relieving techniques (e.g., be there, talk with us, help with positioning, comforting, relaxing, thinking of something else, play, listen to music) helped them cope

Table 5
Summary of the Observational Data at the Different Measurement Times in the Intervention and Control Groups (N = 588)

	Intervention Group n (%) or [95% CI]			Control Group n (%) or [95% CI]		
	T1 n = 105	T2 n = 89	T3 n = 65	T1 n = 160	T2 n = 103	T3 n = 66
Type of medication received						
Acetaminophen (Paracetamol)	92 (88)	80 (90)	56 (86)	134 (84)	91 (88)	58 (88)
Given IV	[81-94]	[84-96]	[78-95]	[78-90]	[82-95]	[80-96]
	24 (28)	23 (29)	41 (73)[a]	34 (32)	48 (53)[a]	31 (53)
	[18-37]	[19-39]	[61-85]	[23-41]	[42-63]	[40-67]
COX inhibitors (NSAIDs)	31 (30)	31 (35)	28 (43)	38 (24)	13 (13)	21 (32)
	[21-38]	[25-45]	[31-55]	[17-30]	[6-19]	[20-43]
NSAIDs and acetaminophen	29 (28)	30 (34)	28 (43)	37 (23)	12 (12)	21 (32)
	[19-36]	[24-44]	[31-55]	[17-30]	[5-18]	[20-43]
Opioids (post)	36 (34)	37 (42)	26 (40)	79 (49)	50 (49)	29 (44)
Opioids[b] ≥.05 mg/kg	[25-44]	[31-52]	[28-52]	[42-57]	[39-58]	[32-56]
	6 (17)	11 (30)	12 (46)	34 (43)	27 (54)	14 (48)
	[4-29]	[14-45]	[26-67]	[32-54]	[40-68]	[29-68]
Use of nonpharmacological methods[c]						
Cognitive/behavioral methods	64 (61)	78 (88)[a]	53 (82)[a]	70 (44)	82 (80)[a]	39 (59)
Preparatory information	[51-70]	[81-95]	[72-91]	[36-52]	[72-88]	[47-71]
Distraction	69 (66)	67 (75)	42 (65)	78 (49)	78 (76)[a]	48 (73)[a]
	[56-75]	[66-84]	[53-77]	[41-57]	[68-84]	[62-84]
Physical methods	22 (21)	30 (34)	19 (29)	26 (16)	42 (41)[a]	16 (26)
Thermal regulation	[13-29]	[24-44]	[18-41]	[10-22]	[31-50]	[14-35]
Positioning	11 (10)	16 (18)	4 (6)	14 (9)	18 (17)	6 (9)
	[5-16]	[10-26]	[0-12]	[4-13]	[10-25]	[2-16]
Emotional support	94 (90)	83 (95)	62 (97)	148 (93)	95 (92)	65 (98)
Presence	[84-95]	[91-100]	[92-100]	[89-97]	[87-97]	[95-100]
Comforting/reassurance	45 (43)	40 (45)	46 (71)[a]	73 (46)	50 (49)	36 (55)
	[33-52]	[34-55]	[59-82]	[38-53]	[39-58]	[42-67]

CI = confidence interval; NSAID = nonsteroidal anti-inflammatory drug; T1 = baseline, T2 = 1 month after the intervention, T3 = 6 months after the intervention.
[a] Statistically significant, $p < .05$.
[b] Morphine or ketobemidone.[c]Used by nurses.

with pain. At T2, fewer children reported moderate to severe pain and more children reported use of pain assessment tools in the intervention group. In the control group there was no change.

Discussion

The main finding in the present study was that the knowledge (total PNKAS-N mean score) increased in both groups after the intervention, but no statistically significant difference between the two groups was revealed. Nurses did not have sufficient knowledge and skills regarding pediatric pain assessment and management at baseline. We found no evidence-based guidelines (on pediatric pain assessment or pain management), lack of pain assessment tools, and nonpharmacological pain-relieving equipment used, and insufficient pain management (e.g., administration of medication, opioid doses, multimodal approach). Children reported moderate to severe pain after surgery, lacked preparatory information, few were pain assessed, and they experienced difficulties swallowing tablets and felt unpleasant receiving a rectal suppository.

However, there were improvements in nurses' knowledge and use of pain assessment tools, and children reported less moderate to severe pain, in the intervention group. Furthermore, there were improvement in nurses' use of nonpharmacological pain management in both groups, and a positive but not significant change in use of multimodal analgesia and correct doses of opioid from baseline to T3.

Changes in Nurses' Knowledge and Attitude of Pediatric Pain Management After the Intervention

Improvement in the total PNKAS-N mean score was revealed between baseline and T2, and sustained at T3 in the intervention group. Increased knowledge of pain management after educational interventions is also reported in similar studies (Dongara et al., 2017; Huth et al., 2010; Kingsnorth et al., 2015; Le May et al., 2009; Lunsford, 2015; Mousa, 2019; Rosenberg et al., 2016). However, in the present study, the total PNKAS-N mean score increased in both groups. Despite the fact that participants in the control group did not receive tailored educational intervention, their total PNKAS-N mean score increased between baseline and T3. This favorable increase in knowledge also in the control group was also found in an RCT by Johnston et al. (2007). Reasons for this improvement may be that the participants have been triggered by the ongoing study to learn more about pediatric postoperative pain management (e.g., the Hawthorne effect; Polit & Beck, 2017). Despite that the improvement in the intervention group was greater than in the control group, there was no statistically significant difference between the two groups. This may be due to higher heterogeneity in the sample than anticipated. There was more variation in the data so we would have needed a larger sample size to reveal the clinically relevant difference as statistically significant.

The differences in the total PNKAS-N mean score between the two groups were above two points (four at T2 and five at T3), which was considered as clinically relevant, and the study was sufficiently powered to reveal such a difference as statistically significant based on our a priori knowledge on variation in the main outcome. However, in line with Johnston et al. (2007), we found large variations within the clusters which was considerably larger than anticipated. Future studies should have larger sample sizes and if possible, include more homogeneous groups.

Changes in Pain Assessment After the Intervention

During the course of the study, an improvement was revealed in nurses' knowledge about pain assessment and nurses' use of pain assessment tools in the intervention group. These findings

were supported by nurses' self-reported use of the tools as assessed by PNKAS-N, and interviews with children, where children reported more use of pain assessment tools at T2. As this study revealed, children did not tell when they were in pain if not asked, it is of clinical importance that nurses use appropriate pain assessment tools and actively involve the children in assessing their pain. Increased use of pain assessment tools after intervention is consistent with findings in similar studies (Ellis et al., 2007; Johnston et al., 2007; Le May et al., 2009).

We found improvements in pain assessment for children aged 5 years or under from 5% at baseline to 36% at T2. This finding is important because these children are particularly vulnerable and unable to self-report their pain, and therefore more dependent on health care professionals (Schug et al., 2020). This finding might be due to particularly weak practices in this area at baseline shown in the present study. A Cochrane review suggests that audit and feedback to improve professionals' practice and health care outcomes are more effective when baseline performance is low (Ivers et al., 2012). Other reasons for the increased use of tools may be that the nurses received pain assessment tools (Ellis et al., 2007) and lectures about the use as part of the intervention, and the use of KT initiatives like workshop, supervision in clinical practice and the high unit involvement, use of change champions, and reminders and posters (Gagnon et al., 2016).

Despite the increased use of pain assessment tools in the present study, more than half of the children were still not assessed with a valid pain tool at 6 months (T3) after the intervention. Reasons here could be that it takes time to translate research into clinical practice (Morris et al., 2011; Stevens et al., 2014), and that the intervals between the intervention and measurements were relatively short. To strengthen the impact of an intervention, increased use of clinical supervision and professional in-service education and training about pediatric pain management should be considered during the implementation (Gagnon et al., 2016; Twycross, 2013). Because many of the nurses had limited knowledge about pain assessment tools for children at baseline, clinical supervision and availability of tools may enhance use in practice. Clinical supervision is resource intensive and only offered to 26% of nurses in our study. Future studies should include more follow-ups to measure the long-lasting effect and include more clinical supervision, professional in-service education and training.

Changes in Pain Management After the Intervention

After the intervention, nurses' knowledge about analgesic drugs improved in the intervention group. As assessed by observation, there were increased use of multimodal analgesia (acetaminophen with COX inhibitors [NSAID]) and correct doses of opioids from baseline to T3, but this increase did not reach statistically significant difference. This concurs to results from similar studies (Ellis et al., 2007; Johnston et al., 2007; Le May et al., 2009). However, Vincent et al. (2011) found that nurses administered significantly more COX inhibitors after the intervention than before in a pilot study with a small sample. Furthermore, Heinrich et al. (2016) found improved documented administration of analgesics after educational intervention. Reasons for this positive change may be due to the KT initiatives repeated in-house training and conceptual changes (e.g., folding card for pediatric surgeons, patient's records, brochure, advanced training sessions for medical staff) during a 3-year period of time.

In the present study, a statistically significantly increased use of intravenous acetaminophen between baseline and T3 was revealed in the intervention group. At baseline, we found inadequate administration of acetaminophen (using oral or rectal administration) which was focused to improve during the intervention. A single intravenous dose of acetaminophen is described to be associated with a reduction in postoperative pain (De Oliveira et al., 2015). The intravenous route for administration of acetaminophen is advantageous, such as providing a faster onset of pain relief and when the oral or rectal route is unsuitable or ineffective. Receiving acetaminophen intravenous is important, especially in the PACUs, because children experienced postoperative nausea and vomiting, having difficulties to swallow tablets and experience it unpleasant and painful to receive suppositories.

In our study the intervention was not specifically targeting the physicians, and pharmacological pain management may be considered to be physicians' responsibility. The educational day was not mandatory for physicians, and only 11 participated the whole day. In addition physicians were not offered clinical supervision. To change clinical practices, it is critical to identify the barriers and to select and tailor the intervention strategies toward the identified barriers (e.g., physicians' knowledge regarding pediatric postoperative pain management; Powell et al., 2017). Insufficient or no prescription of analgesic drugs by physicians, such as our findings at baseline, has been reported as a barrier to effective pediatric pain management (Czarnecki et al., 2014; Twycross, 2013). Future research should consider also involving physicians in similar studies. In the present study, there were no knowledge-based guidelines regarding pediatric postoperative pain management in the units, although it was in work in progress. To strengthen the impact of the intervention, it could have been beneficial to supplement the workshop training with implementation of guideline and changes to administrations forms or prescriptions forms (Gagnon et al., 2016).

During this study, nurses' knowledge and use of nonpharmacological pain management improved in the intervention group. Reasons for this finding may be the awareness of the effect, the nonpharmacological age-appropriate pain-relieving equipment (e.g., DVDs, books, toys, soap bubbles), and clinical supervision they received during the intervention. These findings are consistent with a similar study by Johnston et al. (2007) who found increased documented use of nonpharmacological techniques in the intervention group. However, Le May et al. (2009) did not reveal any improvements in the documented use of nonpharmacological techniques between baseline and 1 month, but they found significant improvement between baseline and 6 months after educational intervention. This might imply that it takes time to make changes. Future intervention studies should consider using multidisciplinary teams, involve the knowledge users (e.g., children receiving pain management) during the intervention to strengthen the intervention and improve the outcome (Gagnon et al., 2016) and include system integration and sustainability measures (Kusi Amponsah et al., 2019).

Feasibility of the Tailored Educational Intervention

Our results revealed knowledge gaps and insufficient pain management at baseline, and a positive change in knowledge and clinical practice in some areas after the intervention. Despite statistically significant improvement in knowledge regarding pharmacological pain management in the intervention group between T1 and T3, there were no statistically significant improvement in clinical practice regarding use of multimodal pain management and correct doses of opioids.

The intervention offered in the present study was partly based on barriers and facilitators identified at baseline, developed using consolidated framework for implementing research, tailored to meet the local needs and included different methods targeting different levels (e.g., individual level or organizational/unit level). The educational day included lectures where they received their own

results from baseline. To enhance the knowledge translation, we used KT strategies like workshop, coaching, audit and feedback and material outreach, which have shown to be effective in other studies (Gagnon et al., 2016; Kusi Amponsah et al., 2019). However, offering an educational day and improving knowledge will not change the behavior alone, and there is a need to pay attention to the implementation and how we disseminate the information to the health care professionals (Braithwaite, 2018). To change practice is difficult because health care is a complex adaptive system, where performance and behavior change over time. The implementation needs to focus on changing context, recognize complexity, and appeal to local agents (Braithwaite, 2018).

Furthermore, in our study we used reminders and local agents to enhance the adaption, implementation, and sustainability of the intervention. The implementation teams were formed at each unit and consisted of local agents (e.g., unit leader team) and the first author. The implementation teams have essential functions keeping the implementation process focused and solving problems that arise (Albers et al., 2020). However, our teams were small and vulnerable and should preferably have been larger and more robust (especially regarding physicians).

In the present study, we actively involved leaders and educators at each unit throughout the project. Furthermore, participants (e.g., nurses and physicians) were participating in workshops during the educational day by discussing relevant patient cases from their own units. The implementation must be active, purposeful, and skillful, with improvement cycles and implementation teams and the key to successful change is to benefit the public, be meaningful and have professional acceptance, be clinical driven, and encourage positive organizational culture (Braithwaite, 2018). During the implementation we had improvement cycles, which included sending emails regularly to follow-up the implementation teams and the reminders (researcher worked in another town). Furthermore, to evaluate the effect of the intervention we measured nurses' knowledge and pediatric postoperative pain management after 1 and 6 months, and the participants received their results after completion of the project. Receiving the results during the implementation could have encouraged them for further improvement. To strengthen the implementation and improved outcome we should have used audit and feedback, in-person training and web-based module also during the implementation process (Glidewell et al., 2018). Furthermore, to secure the sustainability of educational gains it would have been beneficial to develop a responsive program that includes expectations of beneficiaries, and use a multidisciplinary team and to incorporate into existing practice training program (Kusi Amponsah et al., 2019).

Strengths and Limitations

The main strength of the present study was conducting a tailored intervention study with a comparison group using different methodological approaches. Nevertheless, there are some limitations that need to be addressed. Although responsibility for pain management is multidisciplinary, the present study focused on nurses. Both nurses and physicians must have up-to-date knowledge and skills about pediatric postoperative pain management, and multiprofessional collaboration is of great importance.

Another strength was that the present study was conducted on PACUs cover all health regions in Norway, and the university hospitals have both local, regional and national functions. Nurses working in university hospitals may have more knowledge and skills regarding pediatric postoperative pain management than nurses working in local hospitals because they more often care for children undergoing surgery. Although the results may not be representative for children undergoing surgery in local hospitals, they may enable nurses in local hospitals to reflect on their practices given the data collected about practices in university hospitals. It may be reasonable to believe that improved outcomes are more effective when baseline is low (Ivers et al., 2012), which implies that our results may be underestimated.

We used the PNKAS, as in many other studies (Alotaibi et al., 2018; Huth et al., 2010; Johnston et al., 2007; Kusi Amponsah et al., 2020a; Le May et al., 2009; Lunsford, 2015; Omari, 2016; Peirce et al., 2018; Rosenberg et al., 2016; Vincent et al., 2011), which was useful when comparing results. Due to our sample size calculation, all eligible nurses (n = 258) were invited to participate in the survey, and the response rate was 75% at baseline. The level of knowledge among nonrespondents is unknown, but their educational level was not significantly different from the respondents. That nurses responding to the follow-ups had significantly longer work experience as a nurse, compared with the nurses who dropped out during the study, might have led to some selection bias. However, there was no statistically significant difference in total PNKAS-N mean score between the nurses who responded at both T1 and T2, and those who dropped out at T2 at baseline ($p = .124$), which implies that nurses who dropped out at T2 and T3 did it for other reasons than because they found the survey difficult to answer (e.g., quit their job, maternity leave, education).

To obtain a broader view about pediatric postoperative pain management, we used different methodological approaches. PNKAS-N was collected in all six units at all measurement points, but due to time and cost constraints, two units were included for collecting children's experiences at T1 and T2, and four units were included for collecting observational data at T2 and two at T3.

Children and parents were blinded to all measurement points and health care professionals were blinded at baseline. Blinding of participants and personnel is critical in reducing performance bias (Higgins et al., 2011). Blinding was not possible at T2 or T3 as health care professionals knew if they had received educational intervention or not.

The educational day was offered as a one-day seminar, despite evidence that repeated interventions are needed to achieve the translation of knowledge into clinical practice (Stevens et al., 2014). This was done because of time and cost constraints, but to strengthen our study we implemented reminders. Furthermore, our study had three measurement points and only 26% of the nurses received clinical supervision, but to strengthen the study, more follow-ups to measure long-lasting effects and more clinical supervision would have been beneficial.

To minimize the risk of reporting bias (Higgins et al., 2011) we used the Consort 2010 (Supplement A), the Template for Intervention Description and Replication checklist (Supplement B), the Guidelines for Reporting Evidence-based practice Educational intervention and Teaching checklist (Supplement C), and the COREQ (Supplement D).

Implications for Nursing Practice and Research

Barriers to effective pediatric postoperative pain management were identified at baseline. By addressing the different barriers in the tailored intervention this study showed a positive change (such as, lack of pain assessment tools at baseline and increased use of pain assessment tools at T2 and T3). Increased knowledge and use of pain assessment tools alone do not improve pain management if the assessment is not followed by an intervention to reduce the child's pain. To translate research into clinical practice and to change practice takes time (Morris et al., 2011). To strengthen the implementation and improve outcome, audit and feedback, in-person training and web-based module also during the implementation process should have been used (Glidewell et al., 2018). Al-

though the present study showed that pediatric pain management improved in several areas, additional studies with more multidisciplinary approach, and longitudinal studies are needed to assess the effect of an educational intervention study on changes in clinical practice. Furthermore, there is a need to focus more on the implementation and how to disseminate knowledge.

Conclusions

The present study is, to our best knowledge, the first cluster randomized controlled trial using different methodological approaches to assess whether a tailored educational intervention increased nurses' knowledge and improved clinical practice regarding pediatric postoperative pain management in PACUs compared to a control group. We found that nurses lack knowledge and skills in essential pediatric pain management topics, there was inconsistent use of pain assessment tools and insufficient pharmacological pain management at baseline. Children experienced moderate to severe pain after surgery, and pain in other places than the surgical wound. The different methodological approaches helped us gain a broader insight into pediatric postoperative pain management and they complemented each other.

After the intervention, both groups achieved higher scores on the total PNKAS-N mean score; however, no overall statistically significant differences in change were revealed between the groups. Still, in the intervention group, nurses' knowledge and their use of pain assessment tools improved over time and children reported less moderate to severe pain after intervention. Future studies should focus on multidisciplinary, multifaceted and multileveled barriers and facilitators to gain sustainable improvements to clinical practice.

Declarations of Competing Interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.pmn.2021.09.007.

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Appendices

Appendix 1 PNKAS-N Questionnaire

Appendix 2 Observational Study Checklist

Appendix 3 Interview Guides (6–11 Years)

Appendix 4 Interview Guides (12–18 Years)

Appendix 5 Information Letter for Leaders

Appendix 6 Information Letter for Nurses

Appendix 7 Information Letter to Children (6–11 Years)

Appendix 8 Information Letter to Children (12–18 Years)

Appendix 9 Information Letter to Parents

Appendix 10 Search Strategy

Sykepleieres kunnskaper om og holdninger til smerter hos barn

Bakgrunnsdata

Alder _____ år (skriv hele år)

Utdanning

Har grunnutdanning/ bachelor i sykepleie ☐
Er klinisk spesialist ☐
Er barnesykepleier ☐
Er intensivsykepleier ☐
Er anestesisykepleier ☐
Er helsesøster ☐
Har mastergradutdanning ☐
Har doktorgradsutdanning ☐
Har annen utdanning, hvilken: _____

Arbeidserfaring

Hvor mange år har du arbeidet som sykepleier? _____ år (skriv hele år)
Hvor mange års erfaring har du med sykepleie til barn? _____ år (skriv hele år)
Hvor mange år har du arbeidet ved nåværende avdeling? _____ år (skriv hele år)

Hvilken stillingsprosent har du nå? _____ %

Smerter

Har din avdeling skriftlige retningslinjer for smertevurdering av barn og ungdom?
Ja ☐ Nei ☐ Vet ikke ☐

Har din avdeling skriftlige retningslinjer for smertebehandling av barn og ungdom?
Ja ☐ Nei ☐ Vet ikke ☐

Bruker du smertevurderingsverktøy for smertevurdering av barn og ungdom?
Ja ☐ Nei ☐
Hvis ja, Hvilke(n): _____

Sykepleieres kunnskaper om og holdninger til smerter hos barn

Sant / Usant – Sett kryss ved den påstanden du mener er sann eller usann.

S ☐ **U** ☐ 1. For å bekrefte et barns/ en ungdoms utsagn om at han har sterke smerter, må man få bekreftet utsagnet gjennom observerbare forandringer i vitale/fysiologiske tegn.

S ☐ **U** ☐ 2. Barn under 2 år har nedsatt smerteølsomhet og begrenset hukommelse for smertefulle opplevelser, fordi nervesystemet deres ikke er ferdig utviklet.

S ☐ **U** ☐ 3. Hvis spedbarnet/ barnet/ ungdommen kan avledes fra smerter, betyr dette vanligvis at han ikke opplever et høyt smertenivå.

S ☐ **U** ☐ 4. Spedbarn/ barn/ ungdom kan sove til tross for sterke smerter.

S ☐ **U** ☐ 5. Sammenlignbare stimuli gir samme smerteintensitet hos forskjellige personer.

S ☐ **U** ☐ 6. Ibuprofen og andre NSAIDs (ikke-steroide anti-inflammatoriske preparater) er ikke effektive smertestillende midler ved skjelettsmerter.

S ☐ **U** ☐ 7. Ikke-medikamentelle tiltak (f.eks. varme, musikk, fantasireiser) er bare effektive ved kontroll av svake til moderate smerter, men hjelper ikke i det hele tatt ved sterke smerter.

S ☐ **U** ☐ 8. Barn som må gjennomgå gjentatte smertefulle prosedyrer (som daglig sårstell eller blodprøver), utvikler ofte angst for prosedyrene. De bør derfor få maksimal behandling for smerter og angst ved den første prosedyren, for å minimalisere utvikling av angst for de påfølgende prosedyrene.

S ☐ **U** ☐ 9. Respirasjonsdepresjon forekommer sjelden hos barn/ ungdom som har fått opioider over en periode på flere måneder.

S ☐ **U** ☐ 10. Paralgin minor stikkpiller inneholder paracetamol 200 mg og kodeinfosfat 15 mg.

S ☐ **U** ☐ 11. Verdens helse organisasjons (WHOs) smertetrapp anbefaler å bruke èn type smertestillende medikament, fremfor å kombinere ulike typer medikamenter (f..eks. å kombinere et opioid med et ikke-steroid middel).

S ☐ **U** ☐ 12. Den smertestillende effekten av Morfin IV varer vanligvis 5 - 6 timer.

S ☐ **U** ☐ 13. Foreldre skal ikke være tilstede under smertefulle prosedyrer.

S ☐ **U** ☐ 14. Ungdom som har en historie med rusmisbruk bør ikke få opioider for smerter, fordi de har en høy risiko for å utvikle avhengighet på nytt.

S ☐ **U** ☐ 15. Å øke morfindosen over et visst nivå, vil ikke gi økt smertelindring.

S ☐ **U** ☐ 16. Spedbarn under 6 måneder tåler ikke opioider som smertelindring.

S ☐ **U** ☐ 17. Barnet/ ungdommen med smerter bør oppmuntres til å tåle så mye smerter som mulig før en tyr til et smertelindrende tiltak.

S ☐ **U** ☐ 18. Barn under 8 år kan ikke rapportere sin smerte pålitelig. Derfor bør sykepleieren stole på foreldrenes vurdering av barnets smerteintensitet.

S ☐ **U** ☐ 19. Basert på ens religiøse tro kan barn/ ungdom tro at smerter og lidelse er nødvendig.

S ☐ **U** ☐ 20. Angstdempende, beroligende og sovemidler (barbiturater), er hensiktsmessige medikamenter for smertelindring ved smertefulle prosedyrer.

S ☐ **U** ☐ 21. Etter at den første anbefalte dosen med et opioid er gitt, bør påfølgende doser justeres i samsvar med den enkelte pasientens respons.

S ☐ **U** ☐ 22. Barnet/ ungdommen bør rådes til å bruke ikke-medikamentelle teknikker alene, fremfor i kombinasjon med smertestillende medikamenter.

S ☐ **U** ☐ 23. Å gi barn/ ungdom injeksjon med sterilt vann (placebo) er ofte en nyttig test for å avgjøre om smerten er reell.

Multiple Choice – Sett kryss ved kun ETT svaralternativ

24. Den anbefalte administrasjonsmåten for opioider til barn med kortvarige, sterke smerter med akutt start, som ved traumer eller postoperative smerter, er:

- ☐ a. Intravenøst
- ☐ b. Intramuskulært
- ☐ c. Subkutant
- ☐ d. Peroralt
- ☐ e. Rektalt

25. Den anbefalte administrasjonsmåten for opioider til barn med kontinuerlige/ langvarige smerter er:

- ☐ a. Intravenøst
- ☐ b. Intramuskulært
- ☐ c. Subkutant
- ☐ d. Peroralt
- ☐ e. Rektalt

26. Hvilket av de følgende smertestillende medikamentene blir betraktet som førstevalg i behandlingen av langvarige moderate til sterke smerter hos barn?

- ☐ a. Fentanyl
- ☐ b. Kodein
- ☐ c. Morfin
- ☐ d. Petidin

Multiple Choice – Sett kryss ved kun ETT svaralternativ

27. Hvilken av de følgende intravenøse dosene med morfin tilsvarer 15 mg morfin gitt peroralt?

- ☐ a. Morfin 3mg IV
- ☐ b. Morfin 5mg IV
- ☐ c. Morfin 10mg IV
- ☐ d. Morfin 15mg IV

28. Smertestillende medikamenter for postoperative smerter bør innledningsvis gis

- ☐ a. Til faste tider gjennom døgnet.
- ☐ b. Kun når barnet/ ungdommen ber om medikamentet.
- ☐ c. Kun når sykepleieren avgjør at barnet/ ungdommen har moderat eller større ubehag.

29. Et barn med kontinuerlige/ langvarige smerter har fått opioider daglig i 2 måneder. Dosene økte i denne perioden. I går fikk barnet morfin 20 mg/time intravenøst. I dag har han fått 25 mg/time intravenøst i 3 timer. Sannsynligheten for at barnet utvikler respirasjonsdepresjon av klinisk betydning er:

- ☐ a. Mindre enn 1%
- ☐ b. 1-10%
- ☐ c. 11-20%
- ☐ d. 21-40%
- ☐ e. Mer enn 41%

30. Smertestillende medikamenter for kontinuerlige/ vedvarende smerter bør gis:

- ☐ a. Til faste tider gjennom døgnet
- ☐ b. Kun når barnet ber om medikamentet
- ☐ c. Kun når sykepleieren avgjør at barnet har moderat eller større ubehag

31. Den mest sannsynlige forklaringen på hvorfor et barn/ en ungdom med smerter ber om økte doser smertestillende medikamenter er:

- ☐ a. Barnet/ ungdommen opplever økte smerter.
- ☐ b. Barnet/ ungdommen opplever økt angst eller depresjon.
- ☐ c. Barnet/ ungdommen ønsker mer oppmerksomhet fra personalet.
- ☐ d. Barnets/ ungdommens ønske er relatert til medikamentavhengighet.

32. Hvilke av de følgende medikamentene er nyttige i behandlingen av smerter hos barn?

- ☐ a. Ibuprofen (Ibux)
- ☐ b. Morfin
- ☐ c. Amitriptylin (Sarotex; et antidepressivum))
- ☐ d. Alle tre medikamenter

Multiple Choice – Sett kryss ved kun ETT svaralternativ

33. Den som best kan bedømme barnets/ ungdommens smerteintensitet er:

- ☐ a. Behandlende lege
- ☐ b. Barnets/ ungdommens primærsykepleier
- ☐ c. Barnet / ungdommen selv
- ☐ d. Farmasøyten/ andre primære medlemmer av teamet
- ☐ e. Barnets/ ungdommens forelder

34. Hvilket av de følgende utsagn beskriver den beste tilnærmingen for å ta hensyn til kulturell bakgrunn i omsorgen av barn/ ungdom med smerter :

- ☐ a. På grunn av det kulturelle mangfoldet i Norge, blir ikke lenger smerteopplevelse påvirket av kulturell bakgrunn.
- ☐ b. Sykepleiere bør bruke kunnskap som tydelig har definert hvordan kulturell bakgrunn påvirker smerte (f.eks. at asiatere viser få tegn på smerte, spanjoler er uttrykksfulle og overdriver sin smerte etc.)
- ☐ c. Barn/ ungdom bør vurderes individuelt for å bestemme hvorvidt kulturell bakgrunn påvirker deres smerteopplevelse.

35. Hvor stor prosentandel av pasientene tror du overrapporterer sin grad av smerte?
Sett kryss i det du mener er riktig boks.

0	10	20	30	40	50	60	70	80	90	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

36. Avhengighet av narkotiske stoffer/ opioider defineres som psykologisk avhengighet i følge med en altoppslukende interesse for å skaffe og bruke narkotika. Ikke av medisinske årsaker, men for å oppnå en psykisk effekt. Det kan forekomme med eller uten fysiologisk toleranseutvikling og fysisk avhengighet (abstinens).

Med utgangspunkt i denne definisjonen, hvor sannsynlig er det at opioid avhengighet vil oppstå som et resultat av behandling med opioider?

Sett kryss i den boksen du mener er nærmest det riktige svaret.

< 1%	5%	25%	50%	75%	100%
☐	☐	☐	☐	☐	☐

Pasienthistorier

To pasienthistorier presenteres. For hver pasient blir du bedt om å ta beslutninger i forhold til smerter og medikamentell behandling.

Velg kun ETT svaralternativ for hvert spørsmål.

37. Pasient A: Andreas er 15 år gammel, og dette er hans første dag etter operasjonen. I det du kommer inn på rommet, smiler han til deg og fortsetter å snakke og spøke med den som er på besøk. Dine observasjoner viser følgende:

BT = 120/80, hjertefrekvens = 80, respirasjonsfrekvens = 18.

På en skala fra 0 –10 (0 = ingen smerte eller ubehag, 10 = verst tenkelige smerte/ubehag), angir han sin smerte til 8.

A. I pasientens kurve skal du markere hans grad av smerter på skalaen under.

Sett kryss i den boksen som representerer din vurdering av Andreas' smerter:

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Ingen smerte/ ubehag **Verst tenkelige smerte/ ubehag**

B. Den vurderingen du ga over, ble gjort to timer etter at han fikk morfin 2 mg IV. Etter at han fikk morfinen, har han vurdert egne smerter hver ½ time til å variere fra 6 til 8. Han har ingen respirasjonsdepresjon av klinisk betydning, er ikke neddopet, eller har andre uheldige bivirkninger. Han har selv angitt 2 som et akseptabelt smertenivå.

Legens ordinasjon av smertestillende medikament er: "Morfin 1 - 3 mg IV ved behov inntil hver time, til smertelindring".

Hvilket tiltak vil du iverksette på dette tidspunktet?

☐ 1. Ikke gi morfin foreløpig
☐ 2. Gi morfin 1 mg IV nå
☐ 3. Gi morfin 2 mg IV nå
☐ 4. Gi morfin 3 mg IV nå

38. Pasient B: Robert er 15 år gammel, og dette er hans første dag etter operasjonen. I det du kommer inn på rommet hans ligger han stille i sengen, og lager grimaser i det han snur seg i sengen. Dine observasjoner viser følgende:

BT = 120/80, hjertefrekvens = 80, respirasjonsfrekvens =18.

På en skala fra 0 – 10 (0 = ingen smerte eller ubehag, 10 = verst tenkelige smerte/ ubehag), angir han sin smerte til 8.

A. I pasientens kurve skal du markere hans grad av smerter på skalaen under.

Sett kryss i den boksen som representerer din vurdering av Roberts smerter:

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Ingen smerte/ ubehag **Verst tenkelige smerte/ ubehag**

B. Den vurderingen du ga over, ble gjort to timer etter at han fikk morfin 2 mg iv. Etter at han fikk morfinen, har han vurdert egne smerter hver ½ time til å variere fra 6 til 8. Han har ingen respirasjonsdepresjon av klinisk betydning, er ikke neddopet, eller har andre uheldige bivirkninger. Han har selv angitt 2 som et akseptabelt smertenivå.

Legens ordinasjon av smertestillende medikament er: ”Morfin 1 - 3 mg IV ved behov inntil hver time, til smertelindring”.

Hvilket tiltak vil du iverksette på dette tidspunktet?

☐ 1. Ikke gi morfin foreløpig
☐ 2. Gi morfin 1 mg IV nå
☐ 3. Gi morfin 2 mg IV nå
☐ 4. Gi morfin 3 mg IV nå

Ved å fylle ut dette spørreskjemaet, gir jeg mitt samtykke til å delta i studien. Jeg forstår at alle opplysninger behandles konfidensielt.

Observasjonssjekkliste

Studie: **Avd:** **Dato:**

Sykepleier	**1**	**2**	**3**	**4**

Barn Alder og vekt Diagnose Ankom PO R fra PO	**A**	**B**	**C**	**D**
Smertevurdering	J /N	J / N	J / N	J / N
Bruk av smertevurderingsverktøy				
Involvering av barnet				
Involvering av foreldre				
Involvering av kollegaer				
Brukes riktig?				
Når				
Dokumenteres vurderingen?				
Hvilke? Validerte? Var de alders og utviklingsadekvate?				

Appendix 2 **Observasjonssjekkliste**

Barn	**A**	**B**	**C**	**D**
Smertelindring - ikke medikamentell	J / N	J / N	J / N	J / N
Brukes ikke medikamentell				
Involvering av barnet				
Involvering av foreldre				
Involvering av kollegaer				
Når				
Dokumenteres tiltakene?				
Hvilke tiltak				

Appendix 2 **Observasjonssjekkliste**

BARN	**A**	**B**	**C**	**D**
Smertelindring - medikamentell	J / N	J / N	J / N	J / N
Forordnet Er det forordnet? Stående forordning? Ringe for å få forordning?				
Hva er forordnet Medikament, dose, adm måte				
Pre **Hva får barnet?** Medikament, dose, adm måte				
Peri **Hva får barnet?** Medikament, dose, adm måte				
Post **Hva får barnet?** Medikament, dose, adm måte				
Involvering Av barnet Av foreldrene Av kollegaer				
Dokumentasjon Dokumenteres tiltakene? Og hvor?				

Appendix 2 **Observasjonssjekkliste**

Retningslinjer - **Smertevurdering**	**Sykehus**	**Klinikk**	**Avdeling**	
Ja / nei				
Retningslinjer - **Smertebehandling**	**Sykehus**	**Klinikk**	**Avdeling**	
Ja / nei				
Sykepleier	**1** Ja/nei	**2** Ja/nei	**3** Ja/nei	**4** Ja/nei
Følger retningslinjer - smertevurdering				
Følger retningslinjer - smertebehandling				
Kommentar				

Barn A

Appendix 2 **Observasjonssjekkliste**

Barn B

Appendix 2 **Observasjonssjekkliste**

Barn C

Appendix 2 **Observasjonssjekkliste**

Barn D

Oppsummering:

Appendix 3

Intervjuguide
Barn 6-11 år

Hvordan har du det nå?
Hva er det du har gjort her på sykehuset?
Hva er det som er bra/mindre bra?
Kan du fortelle litt om det??
Hvordan er det å være på sykehus?

Hva er smerte/hva er å ha det vondt for deg?

(Snakke litt om hvor de var da de våknet- på postoperativ avd og ikke sengepost. Spørre litt først hva de husker derifra først for deretter hvordan de hadde det når de våknet)

Hvordan hadde du det når du våknet etter operasjonen?
Kan du fortelle litt om det?
Hvordan kjentes det ut der du var operert/reparert?
Kan du fortelle om du hadde vondt noe sted på kroppen?
Har du lyst til tegne på menneskekroppen hvor det var vondt?
Hvordan var det "det vonde" kjentes ut?
Har du kjent noe sånt før?….
Kan du fortelle litt om hva det er å ha vondt for deg?
Var det noe som gjorde at du var redd? ….
Hvordan var det å røre på kroppen når du hadde vondt?
Hvordan var det når du lå helt stille i senga?
Når du hadde det slik, hva skjedde da?
Hva gjorde du da?
Hva skjedde når du begynte å gråte, lå helt stille osv…?
Kan du si noe mer om du hadde noe vondt?
Kan du si noe mer om…
Var det noen som spurte deg om du hadde vondt?

Kan du fortelle hva sykepleierne gjorde når du hadde vondt?
"Ingenting/vet ikke svar"- kan du huske noe som sykepleierne gjorde? (Snakket de med deg, med mamma/pappa, ga medisiner, ga deg drikke osv..)
Kan du huske hva sykepleieren gjorde da?
Husker du hvordan sykepleieren hjalp deg når du hadde vondt?
Hvis ikke sykepleiene hjalp deg, hvem hjalp deg da?
Hva var det mamma/pappa gjorde som hjalp da…?
Har du noen forslag/ideer til hva sykepleieren kan gjøre så du og andre barn får bedre hjelp?
Kan du si noe mer om…

Hva hjalp deg da du hadde vondt?
Kan du fortelle hva du synes hjalp når du hadde vondt etter operasjonen?
Var det noe du gjorde selv som fikk det til å bli bedre?
Hva kan andre kan gjøre så du får mindre vondt?
Hva synes du har vært det beste å gjøre for ikke å ha det så vondt? (Bok, film, medisiner, sove, ligge stille osv..
Er det noe annet som kan hjelpe når du har vondt?
Gjorde mamma/pappa noe som hjalp?

Appendix 3

Linjalen:
Husker du om noen spurte deg om du hadde vondt?
Var det litt vondt, veldig vondt eller midt i mellom?
Har du sett denne linjalen før?
Når du ser på denne linjalen kan du vise hvor du pekte når du hadde det vondt på det aller vondeste?
Når du ser på denne linjalen når tenker du at det er så vondt at du må få hjelp ti å få det bedre?

Appendix 4

Intervjuguide
Barn 12-18 år

Hvordan har du det nå?
Hav er det du har vært her på sykehuset for?
Hva er det som er bra/mindre bra?
Kan du fortelle litt om det??
Hvordan er det å være på sykehus da?

Hvordan hadde du det når du våknet etter operasjonen?
Kan du fortelle litt om det?
Hvordan kjentes det ut der du var operert?
Kan du si noe mer om du hadde noe smerte? Har du lyst til tegne på figuren hvor det var vondt/smertefullt?
Kan du fortelle/beskrive hvordan smerten kjentes ut?
Kan det sammenliknes med noe du har kjent tidligere?
Hvordan opplevde du å ha smerter etter operasjonen?
Hvordan var det å bevege seg når du hadde smerter?
Hvordan var det når du lå helt stille i senga?
Når du hadde det slik, hva skjedde da?
Hva gjorde du da?
Hva skjedde når du begynte å gråte, lå helt stille osv…?
Kan du si noe mer om…
Var det noen som spurte deg om du hadde smerter?

Kan du fortelle hva sykepleierne gjorde når du hadde smerter?
"Ingenting/vet ikke svar"- hva synes du sykepleieren skulle ha gjort?
Hvordan var det sykepleieren hjalp deg når du hadde smerter?
Kan du huske hva sykepleieren gjorde da?
Hvordan hadde sykepleieren funnet ut at du hadde smerter?….
Hvis ikke sykepleiene hjalp deg, hvem hjalp deg da?
Hva var det mamma/pappa gjorde som hjalp da…
Er det noe som sykepleierne kunne gjort på en annen måte?
Har du noen forslag/ideer til hva sykepleieren kan gjøre så du og andre barn får bedre hjelp?
Kan du si noe mer om…

Hva hjelper deg når du har smerter?
Kan du fortelle hva du synes hjalp når du hadde smerter etter operasjonen?
Var det noe du gjorde selv som fikk det til å bli bedre?
Var det noe du gjorde for å kjenne mindre til smerten?
Hva kan andre kan gjøre så du kjenner mindre smerte?
Hva har blitt gjort for å fjerne smertene som har hjulpet deg?
Hvilke tiltak mot smerter synes du har hjulpet deg? (Bok, film, medisiner, leieendring osv..)
Hva synes du har vært det beste å gjøre for å ikke kjenne så mye smerter? (Bok, film, medisiner, sove , ligge stille osv..)
Har du noen tanker om smertebehandling som vi sykepleiere kan fortelle til andre barn som kommer på sykehus?
Kan du si noe mer om…

Appendix 4

Linjalen:
Husker du om noen spurte deg om hvor sterk smerten din var?
Hvordan var det på en skala fra 1-10?
Var det litt vondt- veldig vondt eller midt i mellom?
Har du sett denne linjalen før?
Når du ser på denne linjalen- kan du vise hvor du pekte når du hadde det vondt på det mest smertefulle?
Når du ser på denne linjalen- når tenker du at det er så smertefullt at du må få hjelp ti å få det bedre?

Forespørsel om deltakelse i forskningsprosjektet

«Postoperativ smertebehandling av barn»

Bakgrunn og hensikt
Dette er en forespørsel om å delta i et nasjonalt forskningsprosjekt hvor **hensikten** er å bedre postoperativ smertebehandling av barn i Norge. Dette vil bli gjort ved å utvikle en intervensjon bestående av undervisning, implementere denne og så kartlegge effekten av den. Ulike metodiske tilnærminger vil bli anvendt får å kunne måle eventuell effekt av intervensjonen.

Hva innebærer studien?
Forskningsprosjektet planlegges gjennomført i 2014 - 2015 på postoperative avdelinger ved alle universitetssykehus i Norge. Studien deles inn i tre faser, hvor fase 1 består av kartlegging av postoperativ smertebehandling av barn, fase 2 består av utvikling av intervensjonen, og fase 3 består av implementering og evaluering av intervensjonen. For å gjennomføre studien vil det bli benyttet spørreskjema, observasjon og intervju av barn. Studien vil innebære at sykepleiere svarer på et spørreskjema PNKAS-N (”Pediatric Nurses’ Knowledge and Attitudes Survey Regarding Pain”- norsk versjon) tre ganger; en gang før intervensjon, samt en og seks måneder etter gjennomført intervensjon. Spørreskjemaet er et validert skjema (PNKAS-N) som består av 40 spørsmål som omhandler smertevurdering og smertebehandling av barn. Videre vil halvparten av avdelingene som er med i studien velges randomisert (tilfeldig) til å delta i intervensjon. Intervensjonen vil gjennomføres av smerteeksperter og vil bestå av en temadag med undervisning og workshop basert på resultatet fra spørreundersøkelsen og avdelingens behov.

Det vil også bli gjennomført observasjonsstudier av sykepleiernes smertehåndtering av barn ved flere anledninger under forskningsprosjektet. Første observasjonsstudie gjøres ved samtlige avdelinger ved studiestart for at forsker skal bli godt kjent med avdelingen når det gjelder smertebehandling og se hva sykepleierne har behov for og ønsker å lære mer om. Deretter vil en avdeling fra intervensjonsgruppen og en fra kontrollgruppen bli tilfeldig valgt til å få gjennomført observasjonsstudie etter henholdsvis en og seks måneder.
Likeledes vil det gjennomføres intervju av barn ved to tilfeldig valgte avdelinger ved studiestart og en måned etter intervensjonen. Hensikten er å undersøke hvordan barn og ungdom opplever smertebehandlingen de får etter de har vært igjennom en operasjon.

Mulige fordeler og ulemper
Studien vil kunne føre til økt fokus på temaet og bedret postoperativ smertebehandling av barn. Det vil medføre noe ekstraarbeid for deltakerne ved å fylle ut spørreskjema og evt delta på temadagen. Videre kan det oppleves litt ubehagelig å ha forsker i avdelingen som observerer smertebehandlingen av barn, men dette gjøres for å bli godt kjent med avdelingen og for å se hva sykepleierne har behov for og ønsker å lære mer om. Intervensjonen vil gjennomføres av eksperter i postoperativ smertelindring av barn og skreddersys til avdelingens ønsker og behov. Hver avdeling som er med i studien vil få tilgang til resultatet fra sin avdeling i anonymisert form. De avdelingene som ikke blir trukket ut til å delta på intervensjonen vil få tilbud om dette i etterkant av studien.

Hva skjer med informasjonen?
Informasjonen som registreres skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode vil knytte deltakerne i studien til en navneliste. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten. Det vil ikke være mulig å identifisere enkeltpersoner eller din avdeling i resultatene av studien når disse publiseres**.** Studien er søkt forhåndsgodkjenning ved regional komité for medisinsk og helsefaglig forskningsetikk (REK Sør-Øst), samt ved det lokale personvernombudet på sykehusene. Data vil bli slettet ved prosjektslutt, senest desember 2021.

Studien er for tiden under behandling i etisk komite. Vi vil ikke starte før denne godkjenningen foreligger.

Vi ber herved om godkjenning til å gjennomføre studien ved din klinikk.

Dersom det er behov for ytterligere informasjon/avklaringer i forhold til studien, eller ønsker å få tilsendt forskningsprotokollen, vennligst ta kontakt med Anja Hetland Smeland, tlf: 93015102, mail: anja.smeland@gmail.com.

Med vennlig hilsen:
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Klinikk for kirurgi og nevrofag, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Akuttklinikken, Oslo universitetssykehus og professor ved Universitetet i Oslo

Appendix 5b
Informasjonsskriv til avdelingsledere Oslo, 25.05 2014

Forespørsel om deltakelse i forskningsprosjektet

«Postoperativ smertebehandling av barn»

Bakgrunn og hensikt
Dette er en forespørsel om å delta i et nasjonalt forskningsprosjekt hvor **hensikten** er å bedre postoperativ smertebehandling av barn i Norge. Dette vil bli gjort ved å utvikle en intervensjon bestående av undervisning, implemtere denne og så kartlegge effekten av den. Ulike metodiske tilnærminger vil bli anvendt får å kunne måle eventuell effekt av intervensjonen.

Hva innebærer studien?
Forskningsprosjektet planlegges gjennomført i 2014 - 2015 på postoperative avdelinger ved alle universitetssykehus i Norge. Studien deles inn i tre faser, hvor fase 1 består av kartlegging av postoperativ smertebehandling av barn, fase 2 består av utvikling av en intervensjonen for å styrke sykepleiernes kunnskaper om smertebehandling, og fase 3 består av implementering og evaluering av den utviklede intervensjonen. For å gjennomføre studien vil det bli benyttet spørreskjema, observasjon og intervju av barn. Studien vil innebære at sykepleiere svarer på et spørreskjema PNKAS-N (”Pediatric Nurses’ Knowledge and Attitudes Survey Regarding Pain”- norsk versjon) tre ganger; før intervensjon, samt en og seks måneder etter gjennomført intervensjon. Spørreskjemaet PNKAS-N består av 40 spørsmål som omhandler smertevurdering og smertebehandling av barn. Det tar ca 20 minutter å fylle ut spørreskjemaet. Videre vil halvparten av avdelingene som er med i studien velges randomisert (tilfeldig) til å delta i intervensjonen. Intervensjonen vil bestå av en temadag med undervisning og workshop basert på resultatet fra spørreundersøkelsen og avdelingens behov. Det vil også bli gjennomført observasjonsstudier ved flere anledninger under studien. Første observasjonsstudie gjøres ved samtlige avdelinger ved studiestart, for at forsker skal bli godt kjent med avdelingen når det gjelder smertebehandling og se hva sykepleierne har behov for og ønsker å lære mer om. Deretter vil en avdeling fra intervensjonsgruppen og en fra kontrollgruppen bli tilfeldig valgt til å få gjennomført observasjonsstudie etter henholdsvis en og seks måneder. Likeledes vil det gjennomføres intervju av barn ved to tilfeldig valgte avdelinger ved studiestart og en måned etter intervensjonen.

Mulige fordeler og ulemper
Studien vil kunne føre til økt fokus på temaet og bedret postoperativ smertebehandling av barn. Det vil medføre noe ekstraarbeid for deltakerne ved å fylle ut spørreskjema og evt delta på temadagen. Videre kan det oppleves litt ubehagelig å ha forsker i avdelingen som observerer smertebehandlingen av barn, men dette gjøres for å bli godt kjent med avdelingen og for å se hva sykepleierne har behov for og ønsker å lære mer om. Intervensjonen vil gjennomføres av eksperter i postoperativ smertelindring av barn og skreddersys til avdelingens ønsker og behov. Hver avdeling som er med i studien vil få tilgang til resultatet fra sin avdeling i anonymisert form. De avdelingene som ikke blir trukket ut til å delta på intervensjonen vil få tilbud om dette i etterkant av studien.

Hva skjer med informasjonen?
Informasjonen som registreres skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode vil knytte deltakerne i studien til en navneliste. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten. Det vil ikke være mulig å identifisere enkeltpersoner eller din avdeling i resultatene av studien når disse publiseres**.** Studien er søkt forhåndsgodkjent ved regional komité for medisinsk og helsefaglig forskningsetikk (REK Sør-Øst), samt ved det lokale personvernombudet på sykehusene. Data vil bli slettet ved prosjektslutt, senest desember 2021.

Studien er for tiden under behandling i etisk komite. Vi vil ikke starte før denne godkjenningen foreligger.

Vi ber herved om godkjenning til å gjennomføre studien ved din avdeling.

Dersom det er behov for ytterligere informasjon/avklaringer i forhold til studien, vennligst ta kontakt med Anja Hetland Smeland, tlf: 93015102, mail: anja.smeland@gmail.com.

Med vennlig hilsen:
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Klinikk for kirurgi og nevrofag, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Akuttklinikken, Oslo universitetssykehus og professor ved Universitetet i Oslo

Forespørsel til sykepleiere om deltakelse i forskningsprosjektet

«Postoperativ smertebehandling av barn»

Bakgrunn og hensikt
Jeg er spesialsykepleier som i min doktorgradutdanning ved Universitetet i Oslo vil gjennomføre en nasjonal studie hvor hensikten er å kartlegge postoperativ smertebehandling av barn i Norge, samt se om intervensjon vil bedre postoperativ smertebehandling av barn.

Hva innebærer studien?
Dette er et spørsmål til deg om å delta i en nasjonal studie for å kartlegge sykepleieres kunnskap om smerte hos barn i Norge. Sykepleiere som jobber i direkte pasientarbeid vil bli bedt om å svare på et spørreskjema bestående av 40 avkrysningsspørsmål om smertebehandling av barn og noen bakgrunnsspørsmål om kjønn, alder og utdanning. Det tar deg ca 20 minutter å fylle ut spørreskjemaet, og det er ønskelig at du svarer på dette tre ganger; ved studiestart, samt etter seks og tolv måneder.

Halvparten av avdelingene som er med i studien velges tilfeldig til å delta i intervensjon og de andre vil være med som en kontrollgruppe. Intervensjonen vil bestå av temadag med undervisning og workshop basert på resultatet fra spørreundersøkelsen og avdelingens behov. Er din avdeling valgt ut til å være med i intervensjonsgruppen vil du få tilbud å delta på denne. De avdelingene som er med i kontrollgruppen vil få tilbud om dette når studien er avsluttet.

Det vil også bli gjennomført observasjonsstudier ved flere anledninger under studien. Første observasjonsstudie gjøres ved samtlige avdelinger ved studiestart, for at forsker skal bli godt kjent med avdelingen når det gjelder smertebehandling og se hva sykepleierne har behov for og ønsker å lære mer om. Deretter vil en avdeling fra intervensjonsgruppen og en fra kontrollgruppen bli tilfeldig valgt til å få gjennomført observasjonsstudie etter henholdsvis en og seks måneder.

Hva skjer med informasjonen om deg?
Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste**.** Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres. Dataene vil bli slettet ved prosjektslutt, senest desember 2021.

Frivillig deltakelse
Det er frivillig å delta i studien. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Om du nå sier ja til å delta, kan du senere trekke tilbake ditt samtykke uten å oppgi noen grunn. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte **Anja Hetland Smeland**, tlf: 93015102, epost: anja.smeland@gmail.com.

På forhånd tusen takk!

Med vennlig hilsen:
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Klinikk for kirurgi og nevrofag, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Akuttklinikken, Oslo universitetssykehus og professor ved Universitetet i Oslo

Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

(Signert av prosjektdeltaker, dato)

Jeg bekrefter å ha gitt informasjon om studien

(Signert, rolle i studien, dato)

Spørsmål om å være med i forskningsprosjektet

"Smertebehandling av barn"

Vi lurer på om du vil være med i et prosjekt om smertebehandling til barn og ungdom. I prosjektet vil vi høre med deg om hvordan du hadde det etter opererasjonen og om det var vondt. Målet er å finne ut hva barn og ungdom syns er bra med smertebehandlingen. Vi vil også se om noe kan gjøres bedre.

Hvordan foregår dette?
To sykepleiere vil snakke litt med deg og stille deg noen spørsmål. De har jobbet med barn på sykehus i mange år. Sykepleierne vil snakke med deg i 30-45 minutter, og foreldrene dine kan gjerne være med. Dette gjøres etter du er operert, før du reiser hjem fra sykehuset. Samtalen vil tas opp på lydbånd for at vi lettere skal klare å huske alt du sier. Når vi er helt ferdig med prosjektet vil vi slette alt du har sagt. Ingen kan finne ut hvem du er når de leser om prosjektet senere.

Frivillig å være med
Du bestemmer selv, sammen med foreldrene dine, om du vil være med på dette. Foreldrene dine må skrive under på at du vil være med på dette prosjektet.
Hvis du har sagt ja er det lov å ombestemme seg senere. Det er bare å si at du ikke vil mer. Du trenger ikke å forklare hvorfor. Du får like god hjelp videre på sykehuset.

Hvis du senere finner ut at du ikke vil være med eller har noen spørsmål om prosjektet kan du eller foreldrene dine ringe Anja Smeland på telefon: 93015102.

Tusen takk for hjelpen!

Med vennlig hilsen
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Oslo universitetssykehus og professor ved Universitetet i Oslo

Spørsmål om å være med i forskningsprosjektet

"Smertebehandling av barn"

Dette er et spørsmål til deg om du vil være med i et prosjekt om smertebehandling til barn og ungdom. I prosjektet vil vi høre med barn og ungdom om hvordan de hadde det etter at de ble operert og om det var vondt. Målet er å finne ut hva barn og ungdom syns er bra med smertebehandlingen og hva vi eventuelt kan gjøre bedre.

Hvordan foregår dette?
Hvis du har lyst til å fortelle om hvordan du hadde det etter operasjonen, skriver du og foreldrene dine under på at du vil være med på dette prosjektet. Da vil to sykepleiere snakke litt med deg og stille deg noen spørsmål. De har arbeidet med barn på sykehus i mange år. Sykepleierne vil snakke med deg i 30-45 minutter, og foreldrene dine kan gjerne være med. Dette gjøres etter at du er operert, før du reiser hjem fra sykehuset. Samtalen med deg vil tas opp på lydbånd for at vi lettere skal klare å huske alt du sier. Når vi er helt ferdig med prosjektet vil vi slette lydbåndet og alt du har sagt. Ingen kan finne ut hvem du er når de leser om prosjektet senere.

Frivillig å være med
Du bestemmer selv, sammen med foreldrene dine, om du vil være med på dette.
Hvis du har sagt ja, men likevel ikke vil være med, er det bare å si at du ikke vil mer.
Du trenger ikke å forklare hvorfor. Du får like god hjelp videre på sykehuset.

Hvis du senere finner ut at du ikke vil være med eller har noen spørsmål om prosjektet kan du eller foreldrene dine ringe Anja Smeland på telefon: 93015102.

Tusen takk for hjelpen!

Med vennlig hilsen
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Oslo universitetssykehus og professor ved Universitetet i Oslo

Forespørsel om deltakelse i forskningsprosjektet

"Smertebehandling av barn"

Bakgrunn og hensikt
Dette er en forespørsel til deg om å la barnet ditt delta i et forskningsprosjekt om smertebehandling av barn. Vi ønsker å forbedre smertebehandlingen av barn, og vil gjerne høre mer om barns egne erfaringer fra smertebehandlingen. Hensikten med denne studien er å undersøke hvordan barn og ungdom opplever smertebehandlingen de får etter de har vært igjennom en operasjon. Denne studien er en del av et større forskningsprosjekt hvor hensikten er å kartlegge smertebehandling av barn i Norge.

Hva innebærer studien?
Hvis du og ditt barn samtykker i å delta i studien, vil dere bli bedt om å delta i et intervju. Intervjuet vil gjennomføres av en erfaren barnesykepleier og en erfaren intensivsykepleier og vil vare ca 30-45 minutter. Intervjuet vil gjennomføres etter operasjonen og før dere reiser hjem fra sykehuset.

Hva skjer med informasjonen om deg?
Intervjuet vil tas opp på lydbånd for å sikre at vi får med oss alt som blir sagt under intervjuet. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter ditt barn til opplysninger gjennom en navneliste. Det er kun forskningsgruppen som har tilgang til denne kodelisten. Det vil ikke være mulig å identifisere barnet ditt i resultatene av studien når disse publiseres. De innhentede dataene vil bli slettet når hele prosjektet er ferdig, senest desember 2021.

Mulige fordeler og ulemper
Det vil ta dere ca 30-45 minutter å være med på studien. Ved å være med i studien kan ditt barns erfaringer bidra til å bedre forståelsen av smertebehandling av barn og ungdom, samt bidra til å bedre smertebehandlingen av barn og ungdom i Norge.

Frivillig deltakelse
Det er frivillig å delta i studien. Dere kan når som helst og uten å oppgi noen grunn, trekke deres samtykke til å delta i studien. Dette vil ikke få konsekvenser for ditt barns videre behandling. Dersom dere ønsker å delta, undertegner dere samtykkeerklæringen på siste side. Om dere nå sier ja til å delta, kan dere senere trekke tilbake deres samtykke uten at det påvirker ditt barns øvrige behandling. Dersom dere senere ønsker å trekke dere eller har spørsmål til studien, kan dere kontakte prosjektleder Anja Smeland, tlf: 93015102, epost: anja.smeland@gmail.com.

Tusen takk for hjelpen!

Med vennlig hilsen:
Anja Hetland Smeland, stipendiat ved Universitetet i Oslo, spesialsykepleier og master i klinisk sykepleie, Fag og forskningssykepleier, Kirurgisk avdeling for barn, Oslo universitetssykehus
Tone Rustøen, veileder, forsker, Oslo universitetssykehus og professor ved Universitetet i Oslo

Samtykke til deltakelse i studien

Jeg er villig til å la barnet mitt delta i studien

(Signert av foreldre (mor) til prosjektdeltaker, dato)

Jeg er villig til å la barnet mitt delta i studien

(Signert av foreldre (far) til prosjektdeltaker, dato)

Jeg er villig til å delta i studien

(Signert av prosjektdeltaker over 12 år, dato)

Jeg bekrefter å ha gitt informasjon om studien

(Signert, rolle i studien, dato)

Appendix 10: Search strategy

Detailed searches with assistance from a librarian were conducted in relevant databases (The Cochrane Library, Epistemonikos, Ovid MEDLINE, PubMed, PsychInfo, Chinahl) using the following search terms:

((title:(pain assessment* OR pain measurement* OR pain evaluation* OR pain management* OR pain tool* OR pain test* OR pain scale* postoperative pain OR surgical pain OR postsurgical pain) OR abstract:(pain assessment* OR pain measurement* OR pain evaluation* OR pain management* OR pain tool* OR pain test* OR pain scale* postoperative pain OR surgical pain OR postsurgical pain))

AND (title:(child* OR toddler* OR infant* OR newborn* OR neonate* OR adolescent* OR young* OR youth* pediat* OR paediat*) OR abstract:(child* OR toddler* OR infant* OR newborn* OR neonate* OR adolescent* OR young* OR youth* pediat* OR paediat*))

AND (title:(Self-efficacy OR Attitud* OR Knowledge OR Belief* OR Perception*) OR abstract:(Self-efficacy OR Attitud* OR Knowledge OR Belief* OR Perception*))

AND (title:(nursing education OR staff training OR staff education OR education programme OR health education OR knowledge translation OR knowledge transfer OR continuing education OR educat* OR self-management OR quality improvement OR quality management) OR abstract:(nursing education OR staff training OR staff education OR education programme OR health education OR knowledge translation OR knowledge transfer OR continuing education OR educat* OR self-management OR quality improvement OR quality management))

AND (title:(Perception or Experience or Qualitative studies or Qualitative or Meaning) OR abstract:(Perception or Experience or Qualitative studies or Qualitative or Meaning))

AND (nurse*:ti,ab,kw)

and was conducted in 2013, 2015, 2017, 2019, 2020 and 2022. Manual searches and searches in reference lists in relevant articles were also conducted to discover literature that was not included in the search results.

Separate searches by:

- Postoperative pain
- Pain measurement
- Pain management
- Pain assessment
- Pain tools