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Perioperative nursing – exclusive or inclusive?

Introduction

Perioperative nursing is my specialty area of practice. My practice has included instrument and circulating nurse, unit manager, surgeons' assistant and predominantly education in both hospital and tertiary settings. While working for surgeons I was an instrument nurse, practice nurse and surgeon's assistant. I have experienced, and thus believe, that perioperative practice is about the comprehensive care of patients during their entire perioperative journey.

The term 'perioperative' evolved from the terms used for the work of nurses in operating rooms and operating suites. The prefix 'peri' was used to convey the concept that operating room nurses undertook more than just the intra-operative role – they were involved in the pre-operative, intra-operative and post-operative phases of the patient's surgical experience. Thus was established a framework which allowed an expansion of, and a vision for, the future practice of perioperative nurses with the development of standards for practice and postgraduate education for perioperative practice.

However, perioperative nursing is very much a multidimensional area of practice that has evolved as models of perioperative patient care, surgery, anaesthetics and their complexity, techniques and equipment have evolved. Within the broad perioperative area there are numerous nursing roles. However, they do not all necessarily identify as being under a singular 'perioperative' umbrella and this is largely due to how the roles evolved. Thus the question: is perioperative nursing exclusive, in that it identifies with only one facet of the pre-operative, intra-operative and post-operative phases of the patient's surgical experience? Or is it inclusive, in that nurses who work in any of these phases consider themselves perioperative nurses with a common aim to advance safe, quality perioperative nursing care for Australians?

Evolution

Perioperative nursing roles have evolved from the original instrument and circulating nurses to comprise anaesthesia nurses, post-anaesthesia nurses, day surgery/procedure nurses, nurse surgical assistants, pre-admission nurses and nurse practitioners. Awareness of the need for anaesthesia nurses evolved as the complexity of anaesthetic procedures and equipment developed. The establishment of Post Anaesthesia Care Units (PACUs) began after World War II to safely provide more critical post-operative care. With the evolution of surgical and anaesthetic techniques, post-operative care became more complex.

In the 1980s, when new models of surgical patient care were introduced, day surgery/procedure centres were established. Perioperative nurses undertook expanded roles in these settings of pre-operative assessment and patient education, and post-operative education and discharge planning.

A further advancement of day surgery in the 1990s was day-of-surgery-admission (DOSA) for all types of surgery, major and minor, and the establishment of pre-admission clinics. These clinics are nurse led and have a close collaborative

relationship with operating suite staff; they have also resulted in more extended roles for perioperative nurses. Also in the 1990s, another extension of the perioperative role was that of assistant to the surgeon or perioperative nurse surgeon's assistant (PNSA). With the evolution of the nurse practitioner in Australia, PNSAs and other perioperative nurses have been able to extend their advanced practice and become nurse practitioners (NPs).

Consequences of the evolution process

The roles of nurses evolved and expanded at different rates and with different focuses, and professional organisations representing these roles developed separately. Following World War II, operating room nurses formed professional organisations to address the future growth and development of operating room nursing as a specialty. Australian organisations were formed state by state; the first in 1956 in New South Wales, followed by the other states over the next two decades. In 1977 the Australian Confederation of Operating Room Nurses (ACORN) was formed as the national body representing all the state and territory organisations. ACORN became a College in 2000 and is now the Australian College of Perioperative Nurses.

The Victorian Society of Post Anaesthetic and Anaesthetic Nurses group (VSPAAN) was founded in 1994 to 'provide education for perianaesthesia nurses, as other special interest groups were not addressing their perianaesthesia needs'.[1] In 2005, as it's national membership grew, VSPAAN changed its name to Australian Society of Post Anaesthetic and Anaesthetic Nurses (ASPAAN) and in 2016 ASPAAN became the Australian College of Perianaesthesia Nurses (ACPAN).[1]

The Australian Day Surgery Nurses Association (ADSNA) was formed in 1995 as an association of the day surgery special interest groups in Victoria, New South Wales, South Australia and Western Australia. The Pre-admission Nurses Association (PaNA) was established in 2001, as a result of the increase in pre-admission services across Victoria. It is a special interest group of the Australian Nursing and Midwifery Federation (ANMF).[2]

The first cohort of eight perioperative nurse surgeon's assistant (PNSA) students graduated from Southern Cross University in 2001. The Australian Association of Nurse Surgical Assistants was formed in 2011 with the purpose of obtaining recognition for the PNSA role. The Australian College of Nurse Practitioners (ACNP) came into being in 2010 following the growth of NP roles across Australia.

A vision

Perioperative nursing roles are currently represented by five separate national professional organisations. Of these ACORN and ADSNA are federations of state and territory organisations.

From the Australian Institute of Health and Welfare 2016 report into nursing and midwifery, which uses data from 2015, there were over 24 351 registered nurses working in perioperative nursing – approximately 9.51 per cent of the registered nurse workforce.[3] Today there are over 5000 members of ACORN. This represents approximately 23 per cent of the perioperative workforce. ACPAN has more than 700 members, AANSA has over 100 members and PaNA also has over 100 members.

At the first Australasian Conference of Operating Room Nurses, held in 1977, the perioperative nursing leaders of the time had a vision of a national organisation that would provide strong professional leadership for perioperative nurses. Judith Cornell AM (1940–2014), who was the chair of the committee that organised the conference, was a leader who understood 'the need for solidarity and cohesion between nursing organisations'.[4, p.6] While Judith's comment then applied to the wider nursing community, it can now be applied to perioperative nursing organisations.

If perioperative nursing is exclusive, as suggested by the evolution of multiple roles and the formation of five separate national professional organisations, then the overall strength of the perioperative nursing profession is significantly diminished. The amount of knowledge, skills, expertise and resources within the five separate organisations is substantial, and if perioperative nursing is inclusive then the peak professional bodies representing all the roles that sit under this umbrella should be working collaboratively together to sustain the professions strength and vitality for the future.

Inclusiveness will also promote more research activity. Professor Jed Duff has spoken of the disparity between perioperative research and that of other nursing specialties. Nursing research in emergency departments (EDs) and intensive care units (ICUs) has significantly increased over the past 20 years, whereas perioperative nursing research has remained static. In addition, ED and ICU research are generating four to five times more publications each year than research into perioperative nursing.[5]

The ACORN strategic plan (2019–2022) provides guidance on how such alliances can achieve perioperative strength and vitality. That is by:

- establishing leadership through standard setting

- providing a voice for perioperative nursing
- ensuring the health of the perioperative nursing profession
- building capacity and capability.[6]

The peak professional bodies representing nurses who care for patients during their perioperative journey must work together effectively to achieve the common aim of providing safe, quality, evidence-based care. They must communicate and collaborate on a macro level, and use their knowledge, skills and expertise to identify and act on issues. A summit-like model would focus activities and support research, standards, education, membership, stakeholder networking and consumer liaison. Such an approach can gain a seat at government tables and influence health policy. Just as the patient's perioperative journey is one single event, the peak perioperative professional bodies must adopt an inclusive approach, embrace unity and collaboration so the profession can speak with a single strong voice. This voice will raise the profile of perioperative nursing and sustain the profession's strength and vitality for the future.

When thinking about the separate national perioperative nursing professional organisations, I am reminded of the motto 'united we stand, divided we fall'. Its main premise is that unity and collaboration are more likely to meet with success than individualism. Although the phrase was coined by Aesop in the fable 'The four oxen and the lion', it equally applies to perioperative nurses facing the pressures of working in the current health care system.

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How will the nursing profession remember the Hon Greg Hunt MP?

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On 16 March 2010, the Senate passed historic legislation allowing nurse practitioners (NPs) and midwives limited access to the Medical Benefits Schedule (MBS) and the Pharmaceutical Benefits Schedule (PBS). The Hon Nicola Roxon MP was celebrated as the Minister for Health and Aging who showed courage and conviction for the nursing profession by facilitating this legislation. How will the current Minister for Health and Aging, the Hon Greg Hunt MP, be remembered by the nursing profession?

As I write this, I ponder my operating list for tomorrow. As an NP, I will be the surgical assistant for three patients. All are the same urgent Category 1 procedure in the same private hospital with the same primary surgeon. All patients will receive the same service from me but not all will have to pay for my services. The first patient is privately insured and will pay several hundred dollars 'out of pocket' for my services, as they cannot claim an MBS rebate or a refund from their health fund. The second patient is outsourced from the public sector due to the COVID crisis. They will pay nothing for my services, as the state health department has a contract with the private hospital that will remunerate me and the other clinicians. The last patient will have their expenses paid for by the Department of Veteran's Affairs (DVA).

Why is the private patient financially disadvantaged? Australian legislation sanctions NPs to undertake professional and medical services; and, as an NP surgical assistant, I work collaboratively with the primary surgeon the same way a medical practitioner surgical assistant would. However, Australian NPs are not afforded the same privileges as medical practitioners who have access to MBS patient rebates for many services, including surgical assisting, so private patients cannot claim an MBS rebate for my services even though they can for the same services provided by a medical practitioner surgical assistant. You might be wondering if my private patient is not entitled to an MBS rebate because I am not qualified to undertake the surgical assistant role. Fair question but that's not the reason – to become an NP I completed a master's degree and also completed a second master's degree to undertake the surgical assistant role.

All the patients on my operating list will receive the same service from me but my remuneration will vary. I will be paid for the private patient (by the patient) and the public patient (by the hospital) but, although the DVA would pay a medical practitioner surgical assistant, there is no mechanism for the DVA to pay me so I do DVA patients for free. Why work for nothing, you ask? I feel a duty to because there is a shortage of medical practitioners with skills in the surgical specialty I work in, and the COVID crisis compounds this.

It is not that I haven't tried to change public policy so that my private patients and I are not disadvantaged. I recently completed a PhD so I could provide Australian data, which corroborates international data, showing no difference in patient outcomes whether a doctor or nurse undertakes the role of surgical assistant. Aside from an unsuccessful submission to the Repatriation Commission in 2013 for a rebate for DVA patients, I have made submissions to the Medical Services Advisory Committee (MSAC), in 2013 and 2019, trying to gain access to an MBS patient rebate. In 2013 the federal Department of Health advised that MSAC was not the correct pathway to achieve this; in 2018, they advised that MSAC was the correct pathway but, on the failure of my 2019 application, I was informed that MSAC was not the correct pathway.

If this is not frustrating enough, along with many peak nursing bodies and individual leaders in the nursing profession, I submitted to the recently concluded Medical Benefits Schedule Review Taskforce (MBSRT). The government-appointed Nurse Practitioner Reference Group proposed 14 evidence-based recommendations to the MBSRT to broaden access to the MBS for patients of NPs, thereby increasing patient access to health care. The MBSRT rejected all 14 recommendations, and the Minister for Health did not object.

We are now awaiting the formation of yet another federal Department of Health committee for the ongoing review of the MBS. Given the Department of Health's disinterest in evidence-based recommendations to the MBSRT, I have low expectations that the new committee will recognise the contribution NP surgical assistants make. As this new committee will only meet quarterly, I anticipate having to wait sometime to be disappointed again.

The purpose of the MBSRT and the new Medical Benefits Schedule Review Advisory Committee (MRAC) is to align the MBS with clinical evidence and practice and

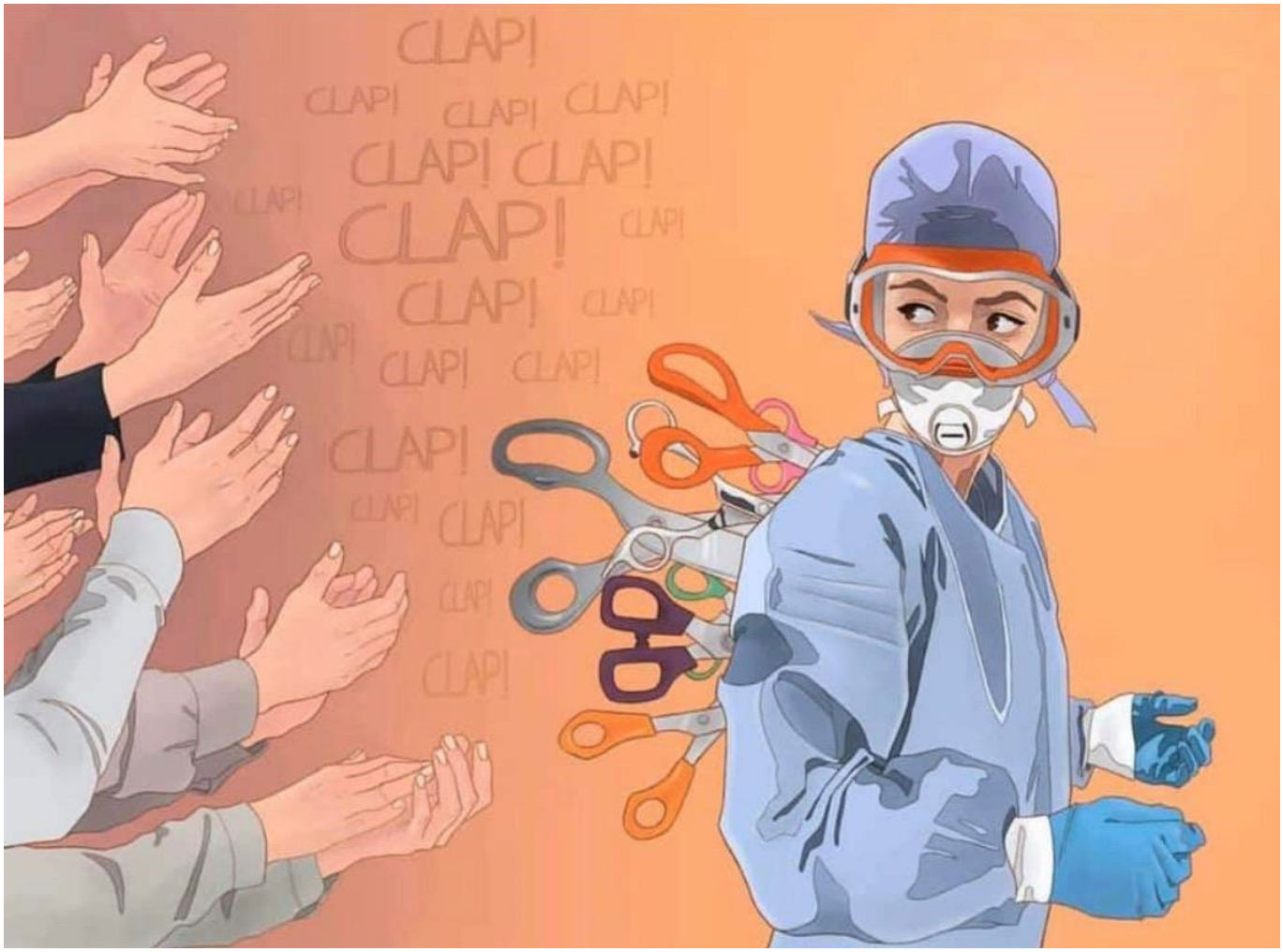

Image by Luis Quiles (Image reproduced with permission from the artist.)

provide recommendations to the Minister for Health and Aging, the Hon Greg Hunt MP.

Pre-COVID, I was at a nursing conference where the Hon Greg Hunt MP addressed the delegates, emphasising how much respect he had for the nursing profession, and disclosed that he was married to a nurse. Certainly, the nursing profession has risen to the COVID crisis challenges and has received applause and adulation from both the public and those who administer the health care system.

As the artist Luis Quiles has superbly portrayed in the artwork that accompanies this letter, those involved in the policy and administration of health care need to do more than applaud the nursing profession. Their respect needs to be translated into fair government health care policy to assist the nursing profession to provide the care they are so willing to offer instead of giving the profession the proverbial stab in the back with anti-competitive health care policy.

I am not sure the nursing professional will remember the Hon Greg Hunt MP as showing courage or conviction when committing to fair and reasonable review processes or advocating on behalf of the nursing profession. In an ideal world, the Minister for Health and Aging would have zero tolerance for anti-competitive behaviour from our health care policymakers, ensuring all Australian health care professionals and consumers have a level playing field when providing or accessing essential health care services. Sadly this has not been the case.

Peer-reviewed article

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Effectiveness of family-centred educational interventions for anxiety, pain and behaviours of children and adolescents and anxiety of their parents during the perioperative journey: A systematic review and meta-analysis

Abstract

Aim: To evaluate the effectiveness of family-centred educational interventions on the anxiety, pain and behaviours of children and adolescents (three to 19 years old) and their parents' anxiety during the perioperative journey.

Design: Systematic review of effectiveness and meta-analysis.

Data sources: MEDLINE, CINAHL, PsycINFO, Cochrane Central Register of Controlled Trials, SciELO and Sources of unpublished studies OpenGrey, Open Access Theses and Dissertations, and RCAAP – Portugal were systematically searched from January 2007 to April 2021 for available articles in English, Spanish and Portuguese.

Review methods: This review followed the methodology for systematic reviews of effectiveness from Joanna Briggs Institute (JBI). Included studies were critically appraised using JBI Critical Appraisal Checklist for Randomised Controlled Trials and JBI Critical Appraisal Checklist for Quasi-Experimental Studies. Data was synthesised through meta-analysis, using a random-effects model in the Stata Statistical Software 16.0, and narrative synthesis. Two independent reviewers performed the selection process, critical analysis, and data extraction.

Results: Twenty-eight studies (26 randomised controlled trials (RCTs) and two quasi-randomised controlled trials) were included with a total of 2516 families. In a meta-analysis of ten RCTs with 761 participants, pre-operative anxiety management was more effective in children and adolescents who received educational interventions (SMD = -1.02; SE = 0.36; 95% CI [-1.73; -0.32]). At the induction of anaesthesia, children and adolescents were significantly less anxious (SMD = -1.54; SE = 0.62; 95% CI [-2.72; -0.36]) and demonstrated better compliance than controls (SMD = -1.40; SE = 0.67; 95% CI [-2.72; -0.09]). Post-operative pain (SMD = -0.43; SE = 0.33; 95% CI [-1.05; 0.19]) and pre-operative parental anxiety (SMD = -0.94; SE = 1.00; 95% CI [-2.87; 0.99]) were reduced in favour of the educational interventions.

Conclusion: Family-centred educational interventions probably lead to a considerable reduction of paediatric and parental anxiety and improve paediatric behaviours at induction of anaesthesia. The evidence is very uncertain regarding the effectiveness of these interventions on post-operative paediatric maladaptive behaviours and pain intensity or parental anxiety levels at the induction of anaesthesia.

Summary of findings

Effects of educational interventions on child and adolescent anxiety, pain and behaviours during the perioperative journey

Patient or population: Children and adolescents from three to 19 years old undergoing elective surgery.
Setting: Hospital. **Intervention:** Educational intervention. **Comparison:** Standard care / comparator.

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of evidence (GRADE)	Comments
	Risk with standard care/ comparator	Risk with educational interventions				
Anxiety – pre-operative period	–	SMD 1.02 SD lower (1.73 lower to 0.32 lower)	–	761 (10 RCTs)	●●●○ MODERATE	Educational interventions probably lead to a reduction in pre-operative paediatric anxiety levels. Downgraded to moderate certainty for serious imprecision, inconsistency and publication bias.
Anxiety – induction of anaesthesia	–	SMD 1.54 SD lower (2.72 lower to 0.36 lower)	–	598 (7 RCTs)	●●●○ MODERATE	Educational interventions probably lead to a reduction in paediatric anxiety levels at the induction of anaesthesia.
Anxiety – post-operative period	–	SMD 2.33 SD lower (4.25 lower to 0.40 lower)	–	301 (4 RCTs)	●●●○ MODERATE	Educational interventions probably lead to a large reduction in paediatric anxiety levels post-operatively. Downgraded to moderate certainty for serious imprecision, inconsistency and publication bias.
Behaviour – induction of anaesthesia	–	SMD 1.40 SD lower (2.72 lower to 0.09 lower)	–	240 (2 RCTs)	●●●○ MODERATE	Educational interventions probably improve paediatric behaviours at the induction of anaesthesia. Downgraded to moderate certainty for serious imprecision, inconsistency and publication bias.
Behaviour – post-operative period	–	SMD 0.12 SD higher (0.84 lower to 1.09 higher)	–	172 (2 RCTs)	●○○○ VERY LOW[a]	We are uncertain if family-centred educational interventions reduce or increase child and adolescent post-operative maladaptive behaviours.

Effects of educational interventions on parental anxiety during the perioperative journey

Patient or population: Parents of children and adolescents from three to 19 years old undergoing elective surgery.
Setting: Hospital. **Intervention:** Educational intervention. **Comparison:** Standard care / comparator.

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of evidence (GRADE)	Comments
	Risk with standard care / comparator	Risk with educational interventions				
Anxiety – pre-operative period	–	SMD 0.94 SD lower (2.87 lower to 0.99 higher)	–	361 (6 RCTs)	●●●○ MODERATE	Family-centred educational interventions probably lead to a reduction in parental anxiety levels pre-operatively. Downgraded to moderate certainty for serious imprecision, inconsistency and publication bias.
Anxiety – induction of anaesthesia	–	SMD 0.55 SD lower (1.78 lower to 0.67 higher)	–	376 (3 RCTs)	●○○○ VERY LOW[a]	We are uncertain if family-centred educational interventions reduce parental anxiety levels at the induction of anaesthesia.
Anxiety – post-operative period	–	SMD 1.64 SD lower (3.05 lower to 0.23 lower	–	203 (3 RCTs)	●●●○ MODERATE	Family-centred educational interventions probably lead to a reduction in parental anxiety levels post-operatively. Downgraded to moderate certainty for serious imprecision, inconsistency and publication bias.

Introduction

Millions of children and adolescents undergo surgery each year.[1] Nearly 50 to 75 per cent of them experience fear and anxiety during the perioperative period,[2] feelings also reported as very common in their parents[3–5]. The perioperative journey comprises the pre-operative, intra-operative and post-operative periods[6,7]. Children are particularly vulnerable to the stress and anxiety surrounding surgery due to their cognitive development, experience and knowledge about health care.[8] Parental fear, anxiety and trauma are mirrored by parents' need for comprehensive information and advice about as well as strategies for coping with their child's surgery.[5] Higher anxiety levels have been found in mothers,[9] younger parents, parents of younger children, and parents whose children were undergoing their first surgery.[10]

High anxiety levels in children have been associated with a multitude of adverse outcomes post-operatively,[1,11,12] namely increased pain and necessity for higher analgesia doses and regressive behavioural disorders,[13] such as nightmares, enuresis, separation anxiety and eating and emotional problems.[14,15] Ultimately, the former can lead to a regression on previously gained developmental milestones such as loss of bladder control and language abilities,[16] especially in younger children.[15] Parental anxiety influences how the child will respond emotionally and physically[17] to the stress of surgery.[18] It has been linked with increased anxiety levels in the children[19–21] and post-operative maladaptive behavioural changes in the children.[14] Therefore, effective management of anxiety is essential.[1]

Proposed mechanisms for anxiety reduction comprise pharmacological and non-pharmacological strategies.[12,22] The first include the administration of anxiolytic premedication[23] pre-operatively. Although beneficial,[24,25] it has its side effects, and has been associated with increased hospital costs due to extended stays in recovery areas[11] and delays entering the operating theatre.[2,26] Non-pharmacological strategies encompass the adoption of educational, behavioural and psychological interventions,[12,22] including parental presence during induction of anaesthesia,[27] and complementary medicine interventions.[12]

Pre-operative preparations based on educational interventions are an important component of the surgical process.[28] These are cost-effective, non-invasive and carry a low risk of adverse effects.[12] Family involvement is critical, as parents are a primary source of strength and support[29] and know their child best. Parents play an important role as information providers to their children and are considered to be the ones children can rely on for information.[30,31] Therefore, active parental involvement in the care provided can positively affect the children's health outcomes and satisfaction as well as lower hospital costs.[32,33] A family-centred approach to care should be adopted when preparing the parent–child dyad for surgery in order to optimise their outcomes.[33]

Providing children, adolescents and parents with information about the upcoming surgery – particularly regarding the expected pre- and post-operative period, and the signs and symptoms that result from the surgical intervention – helps them manage realistic expectations about the perioperative journey.[31,34] It also supports the family in developing adaptive coping mechanisms, minimising their anxiety and promoting faster recovery of their children.[2,12] In addition, detailed, developmentally appropriate[34] and specific pre-procedural information – such as how long the procedure will take, what will happen, who will be there and what the surgical environment is like – helps children develop a realistic representation[35] of the day of surgery and, consequently, increases their cooperation throughout the perioperative

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

CI = confidence interval, SMD = standardised mean difference

GRADE Working Group grades of evidence:

- High certainty – we are very confident that the true effect lies close to that of the estimate of the effect
- Moderate certainty – we are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
- Low certainty – our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect.
- Very low certainty – we have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of the effect.

[a] Included studies with low number of participants. Different measurement instruments and diverse range of educational material have been used.

period.[34] Moreover, it can affect the family's knowledge, attitudes and satisfaction,[36] transforming a potentially stressful and negative experience into a formative and empowering one.[37]

Information provided to the family during the perioperative journey can take different forms: verbal, written or both. Books, pamphlets, guides, teaching programs or sessions (whether face-to-face, via web or audio), games for children, videos and DVDs are examples of active materials used when delivering educational interventions.[34,38–40]

The timing of delivering educational interventions is an important factor that must be taken into consideration. Research suggests at least five days in advance for school-aged children and adolescents, whereas a shorter timeframe is more beneficial for younger children.[12,30,34]

Interventions to manage pre-operative anxiety have been previously investigated.[37,39,41–44] However, many of these interventions have been tailored for and targeted at children and did not involve the family. Moreover, some have focused on exclusively controlling the children's pre-operative anxiety based on behavioural changes. Although two systematic reviews on the topic have explored the impact of technology-based[39,43] preparation programs on children's and parents' anxiety, there is still the need to summarise the evidence about the effectiveness of educational interventions delivered in a family-centred approach during the perioperative journey for both children and parents.

A preliminary search of PROSPERO, MEDLINE, CINAHAL, the Cochrane Database of Systematic Reviews, and *JBI Evidence Synthesis* was conducted on 5 March 2021 and no current or underway systematic reviews on the topic were identified.

The objective of this systematic review is to evaluate the effectiveness of family-centred educational interventions on the anxiety, pain and behaviours of children and adolescents (three to 19 years old) and their parents' anxiety during the perioperative journey. This review did not involve primary research and therefore ethical approval was not required.

Review questions

1. What is the effectiveness of family-centred educational interventions in the anxiety, pain, and behaviours of children and adolescents (three to 19 years old) during the perioperative journey?
2. What is the effectiveness of family-centred educational interventions on parents' anxiety during the perioperative journey?

Methods

Design

This systematic review was conducted in accordance with Joanna Briggs Institute (JBI) methodology for systematic reviews of effectiveness[45] and reported using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.[46] This review has been registered in PROSPERO (CDR42020211574) and conducted in accordance with the *a priori* protocol.[47]

Eligibility criteria

The population of interest were parents and their children aged between three and 19 years old who were undergoing elective or scheduled surgery under general anaesthesia, regardless of the type of surgery. Parent refers to the relative or 'caregiver' – the person responsible for the child. Regarding the child or adolescent's age, the lower age limit was set at three as children from three years of age can understand simple language, are able to communicate autonomously and benefit from therapeutic play.[48] Children and adolescents undergoing local or regional anaesthesia were excluded.

Studies were required to have evaluated family-centred educational interventions performed with children or adolescents and their parents during the perioperative journey. These could include any printed, written materials such as books, booklets or guides; teaching sessions or programs, whether face-to-face, via the web or audio, and games, videos, or DVDs. There were no limitations to the mode of delivery, frequency, dose or who delivered the intervention.

All family-centred educational interventions that aimed to manage the study outcomes, either applied as a single educational intervention or as a multi-component educational program (more than one of the interventions reported above), were included. Outcomes included the children and adolescents' pain, anxiety and behaviours (such as compliance at induction of anaesthesia, sleep and emotional disorders post-operatively) and anxiety in parents.

Experimental and quasi-experimental study designs including randomised controlled trials (RCTs), non-randomised controlled trials and before-and-after studies published in Portuguese, English or Spanish were included in this review.

Search strategy and study selection

A three-step search strategy was undertaken and aimed to find both

published and unpublished studies. First, an initial limited search of MEDLINE (PubMed) and CINAHL (EBSCOhost) was undertaken, followed by an analysis of the text words in the title and abstract and the index terms used to describe the articles. The search strategy, including all identified keywords and index terms, was adapted for each included information source and a second search was undertaken between 3 and 13 April 2021. The full search strategies are provided in supplement 1. Finally, reference lists of studies were screened for additional studies, namely, references of studies included in the systematic review and references of systematic reviews on similar topics.

Studies from 1 January 2007 to April 2021 were included. This date range was chosen as it was in 2007 that the paediatric family-centred surgical preparation became prominent and structured.[11]

The searched databases included MEDLINE (via PubMed), CINAHL (via EBSCOhost), PsycINFO (via EBSCOhost), Cochrane Central Register of Controlled Trials (via EBSCOhost), and SciELO. In addition, sources of unpublished studies and grey literature searched included OpenGrey, Open Access Theses and Dissertations, and *Repositório Científico de Acesso Aberto em Portugal* (RCAAP).

Following the search, all identified citations were collated and uploaded into EndNote X9.3 (Clarivate Analytics, PA, USA) and duplicate records were removed. A pilot test of fifty titles and abstracts was performed to improve screening strategy and avoid deviations. The remaining titles and abstracts were screened by two independent reviewers (IE, MC) for assessment against the inclusion criteria for the review. Potentially relevant studies were retrieved in full, and their citation details were imported. Authors of papers were contacted to request missing or additional data for clarification, where required. Full-text studies that did not meet the inclusion criteria were excluded, and reasons for their exclusion are provided in supplement 2. Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer (MPS).

Quality appraisal

Eligible studies were critically appraised by two independent reviewers (IE, MC) at the study level for methodological quality in the review using JBI Critical Appraisal Checklist for Randomised Controlled Trials and JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomised experimental studies).[45] All items have three potential responses 'yes', 'unclear' and 'no', with 'yes' scoring 1, and the others 0. Once again, any disagreements between the reviewers were resolved through discussion or with a third reviewer (MPS).

Following the critical appraisal, studies that did not reach a quality threshold (at least seven affirmative indicators for RCTs and six for quasi-experimental studies) were excluded. This decision was based on the reviewers' overall assessment of quality and risk of bias.

Data extraction and synthesis

Data were extracted using a structured form (IE, MC) which included specific information as detailed in supplement 3. When possible, studies were pooled with statistical meta-analysis using Stata Statistical Software version 16.0.[49] To perform meta-analysis, studies whose results were presented as medians and respective interquartile ranges underwent conversion to mean and standard deviation estimates.[50] Effect sizes, expressed as Hedges' standardised final post-intervention mean differences (for continuous data), and their 95 per cent confidence intervals, were calculated for analysis. Given the statistical heterogeneity (I^2>50%)[51] of educational interventions implementation between the included RCTs, and between-study and within-study differences, pooling of the effectiveness of these interventions was carried out using the random-effects model.[51]

Considering the low number of studies presenting results of the effects of educational interventions on the outcomes of the family, it was not possible to analyse the effect of each intervention independently. Subgroup analysis was performed to explore potential causes of heterogeneity and how the intervention effect varied according to the number of interventions implemented. Therefore, the authors divided the interventions into two subgroups – 'multi-component educational programs' in which more than one educational intervention was applied to the family and 'single educational interventions' in which only one intervention was delivered. The overall effect was also presented. Where there were sufficient data, meta-analysis was performed by outcome, follow-up moment and subgroup.

Sensitivity analyses were conducted to test whether the pooled effect size could be influenced by individual studies. Heterogeneity was assessed statistically using the standard χ^2 and I^2 tests. Funnel plots were generated to assess publication bias. Statistical tests for funnel plot asymmetry (Egger test) were performed, where appropriate. A p-value of less than 0.05 was considered significant for

absence of publication bias.[52] Where meta-analysis was not possible, the findings are presented in a narrative format.

Assessing certainty in the findings

The Grading of Recommendations, Assessment, Development and Evaluation (GRADE)[53] approach for grading the certainty of evidence was followed, and a Summary of Findings (SoF) was created using GRADEPro GDT (McMaster University, ON, Canada). The outcomes reported in the SoF were anxiety, pain and behaviours for children and adolescents, and anxiety for parents.

Results

Study identification and inclusion

A total of 85 studies were retrieved for full-text review. Of these, 57 articles were excluded (see supplement 2 for a list of the articles and reasons for exclusion). The study identification is described in detail in Figure 1.

Characteristics of included studies

All included studies in this review were written in English and published between 2007 and 2021. Studies were conducted in hospital settings in Canada,[54] Korea,[55–58] Turkey,[59–62] India,[63,64] Iran,[65–67] Australia,[68] Italy,[69] Taiwan,[70] Singapore,[40] Hong Kong,[71] France,[72] Belgium,[73] Portugal,[74,75] Japan,[76] Egypt,[77] Brazil[78,79] and the Netherlands[80].

Sample sizes ranged from 36 to 282 participants per study. The main reasons for 'dropouts' were cancelled surgery,[54,57,70,71,76] did not receive the allocated intervention,[55,68] the participants were no longer interested,[71] and failure to check outcomes' scores or inadequate data.[57,65]

The majority of the participants underwent otolaryngologic surgery,[40,54,56–58,61,62,65,68,79,80] followed by genitourinary surgery[60,63,71,74–76] and ophthalmic surgery.[56-58,68] Children were excluded from the studies if they required post-operative intensive care[55-58] or had previous surgical or post-anaesthetic complications,[54] cognitive deficits or developmental disabilities,[55–63,67–71,73-75,77–80] prior experience of anaesthesia/surgery,[55–57,59,60,65,67,68,71,78,79] history of epilepsy or seizure[55–58,77] or chronic disease.[60–62,67,70,71,77] Parents and guardians who did not speak the language,[54,63,73,74,76,80] and were unable to complete self-report forms[68] or to accompany their child[70] were also excluded. The demographic and clinical variables did not significantly differ between the experimental and control groups in all studies.

The timing for the delivery of educational interventions was variable from study to study ranging from two weeks[65] up to a few minutes[65] before surgery. In addition, two studies did not detail when the intervention was applied[54,61]. The duration of the educational interventions ranged from four minutes[55,57] to one hour[40]. Modes of delivery included face-to-face contact with the family alone or in a group setting[63,71] (more than one family) and at the hospital or at home, tailored for the participation of the dyad, child or caregiver. All studies used direct contact with the participants to evaluate the interventions. Finally, follow-up duration varied from a minimum of the time as an inpatient (from hospital admission to discharge) to two weeks post-operatively.

Conflicts of interest were disclosed as some authors have been involved in the development of the educational material[59,73] and 14 studies were funded by local[54,66,68–71] and national institutions[40,54,56,72,74,75] and industry (IONIX Ltd.).[55,57,58]

Educational interventions

The educational interventions focused on systematic explanations about pre- and post-operative care[60,61,63,65,72,77–79] (i.e. pre-operative fasting time, personal hygiene, control of vital signs, anaesthesia and post-operative use of analgesic drugs to relieve pain), including how to prepare a child for surgery,[60–62,72,73,76] types of anaesthesia,[63,78,79] potential reactions of children waking up after surgery,[54,78,79] post-operative pain management[40,70,73] and strategies that parents and caregivers could use to support their child in the post-operative period.[54,65] Additionally, there were educational interventions aimed at facilitating the children's adaptation to the operating room environment, through virtual reality[55–58,80] and other methods,[40,63,64,67–71,77] and interventions to increase knowledge about pre-operative processes undergone after admission[40,57,59–62,66,68,71–76,80] and the equipment most commonly used.[40,56–59, 62,65,67,69–71,74,77,80] Interventions also provided parents with knowledge about the equipment and procedures in the recovery room, and the roles of nurses and parents in supporting their child,[54,78,79] In many studies, children and their parents were encouraged to ask questions about the pre-operative procedures.[55–58,60,69,71]

Among the materials used to support the educational interventions were DVDs,[54,65] videos,[40,55,57,58,62,63,69,70,74,76,80] booklets,[40,59,60,66,74,76] leaflets,[64,72,78,79] books,[60,61] one-hour of face-to-face teaching,[40] verbal information,[60] therapeutic play,[59,65,67,71,77] demonstration of equipment using the peer modelling approach,[68] familiarisation with equipment,[70]

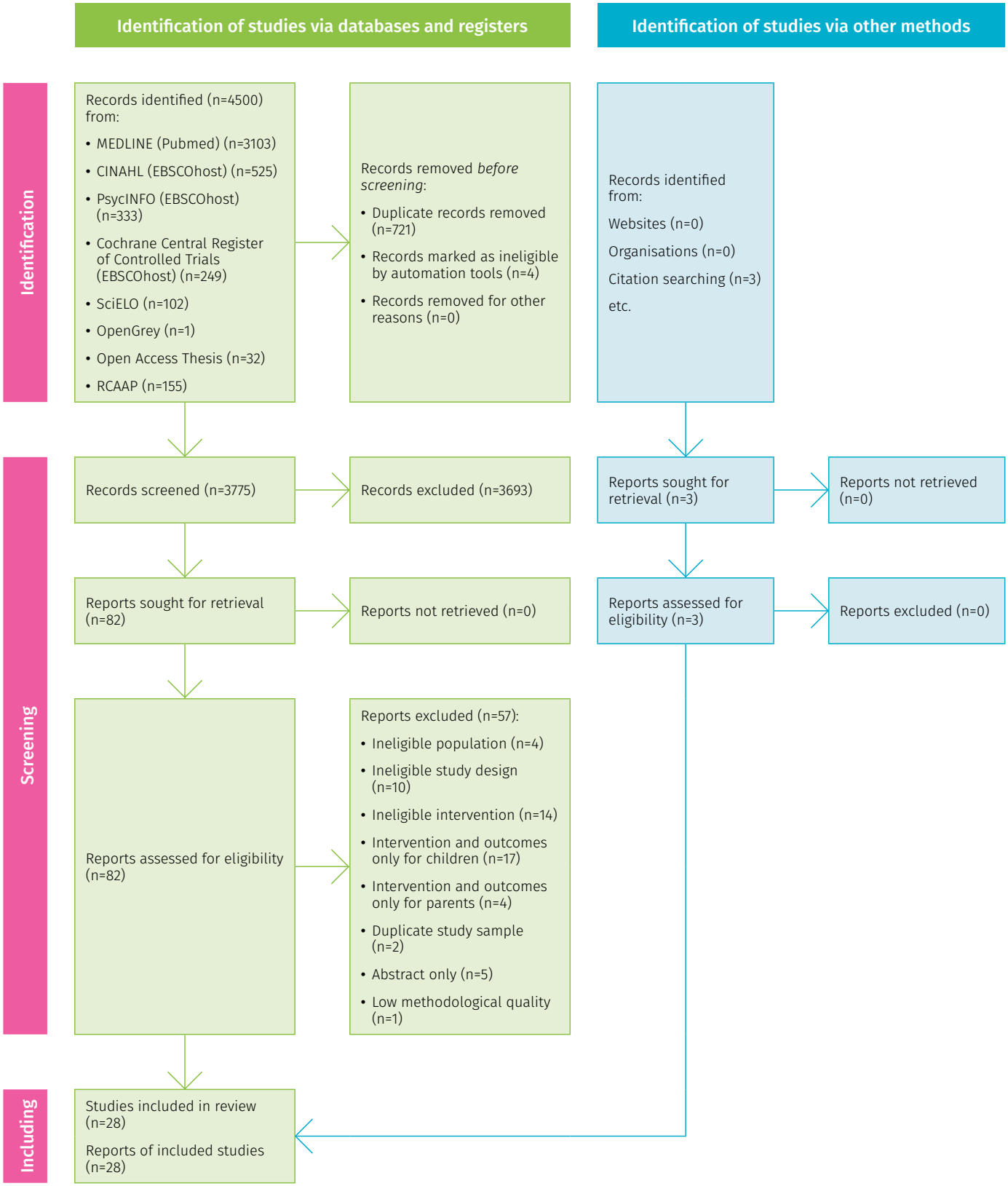

Figure 1: Search results, study selection and inclusion process[46]

tour visits,[59,66–68,70,77] photo files[64,68] and games.[56,73–75] Nine studies were pre-operative programs[40,59,60,64,65,67,68,70,77] that encompassed the use of more than one material. Only one study[55] reported dizziness associated with the delivery of the intervention in one participant (child).

Comparators

The comparators used in the studies were standard pre-operative care (without intervention),[40,54–57,59,60,62–64,66–73,75,77–80] intervention with non-educative materials,[61] multi-component preparation programs with more than one intervention and materials used versus comparator groups (with one educational intervention),[65] the non-involvement of the family,[58] absence of auxiliary materials when delivering the educational intervention,[74] and the intervention's frequency of delivery.[76]

Outcomes

Children's and adolescents' anxiety

Regarding the outcomes and assessment tools, pre-operative anxiety in children and adolescents was assessed using the Visual Analogue Scale for anxiety (VAS-a),[73,80] FACES Rating Scale,[76] the State–Trait Anxiety Inventory for Children (STAIC),[59,64,66,72,77] the State–Trait Inventory form Y (STAI-Y),[75] the modified Yale Pre-operative Anxiety Scale (m-YPAS),[56–58,61,62,67–69,79,80] the Hamilton Anxiety Rating Scale (HAM-A),[63] the Chinese version of the State Anxiety Scale for Children (CSAS-C),[71] and the Spielberger State Anxiety Scale for Children (SSAS-c).[67] These instruments were measured either by the child[59,64–67,72,73,76,80] (self-reported), the parents[73] or by the study assessors[55–58,61,62,68,69,71,78–80] at home (post-intervention),[73] day before surgery,[59,64,77] day of surgery,[56–58,63,66,67,69,71–73,75] in the holding area,[55,61,67,79,80] while entering the operating room[61,67] and at induction of anaesthesia.[62,79,80] Additionally, some studies assessed the anxiety post-operatively.[59,64,71]

Seventeen studies[56,58,59,61,63,64,66–69,71–73,76–78,80] intended to investigate whether the pre-operative post-intervention anxiety levels differed for participants undergoing educational interventions from those undergoing standard care. Fourteen studies[56,58,63,66–69,71–73,75–78] found positive effects of educational interventions on reducing children's pre-operative anxiety, ten of these had statistical differences between groups ($p \leq 0.05$).[56,58,63,67,69,71,72,75–77]

At induction of anaesthesia, authors of five[55,57,61,62,78] out of seven studies,[55,57,61,62,78–80] reported lower anxiety levels in the participants who received educational interventions pre-operatively, with statistical differences between groups.

Six studies[59,64,68,71,76,80] evaluated post-operative anxiety levels in children and adolescents, four of these[64,71,76,80] reported lower anxiety levels in the experimental groups.

Parental anxiety

Parental anxiety was self-reported[54,58–61,63,64,66,68,70,72–78,80] and observed[80] using predominantly the State–Trait Inventory (STAI),[60,61,64,66,68,72,74,76,77,80], the Amsterdam Pre-operative Anxiety and Information Scale (APAIS),[70] the Visual Analogue Scale for Anxiety (VAS-a),[54,80] the 101 Numeric Rating Scale,[58] the Hamilton Anxiety Rating Scale (HAM-A),[63,67,78] and the Beck Anxiety Inventory (BAI).[59] These instruments were used pre-operatively[58–61,63,64,66,67,77,80] and post-operatively.[54,59,60,64] Parents in the experimental group showed less anxiety before surgery than the ones in the control group[60,63,66,68,75–78]. Two studies did not find significant differences between groups.[64,66] Similar results were found post-operatively in four studies.[54,59,60,64]

Children's and adolescents' behaviours

In order to assess children's behaviours during stressful medical events like surgery, blinded observers have applied the Children's Emotional Manifestation Scale (CMES)[70,71] and the Procedural Behaviour Rating Scale (PBRS).[55,56] Pre-operative behaviour scores in the experimental group were three points lower than those in the control group, with children exhibiting fewer emotions at induction of anaesthesia.[70,71] Also, three[55,56,77] of four studies[55,56,58,77] reported better compliance of participants in the experimental group, with statistical significance between groups. The children's compliance during induction of anaesthesia was observer-rated using the Induction Compliance Checklist (ICC).[55,56,58,77] High scores indicate poor behavioural compliance, whereas lower scores indicate good compliance.

The incidence of emergence delirium in children undergoing elective surgery was determined by the Paediatric Anaesthesia Emergence Delirium score (PAED)[57,70,80] and the Scoring System for Emergence Delirium.[68] Among the studies, no differences were found between groups in the incidence of emergence delirium symptoms upon arrival at the recovery room or at 15 minutes after arrival.[56,70,80]

Post-operative behavioural disturbances such as difficulty getting to sleep, nocturnal enuresis, fear of the dark, objecting to go to bed at night and decreased appetite were investigated and assessed in five studies through the Post-Hospitalisation Behavioural Questionnaire.[55,68,70,73,77] Children with high anxiety levels at induction

Table 1: Critical appraisal results of eligible randomised controlled trials (RCTs)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Chartrand et al. (2017)[54]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ryu et al (2019)[57]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ryu et al (2018)[56]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Coskunturk et al (2017)[59]	Y	Y	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y
Park et al (2019)[58]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Yadav et al (2020)[63]	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Faramarzi et al (2020)[65]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Fincher et al (2012)[68]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Liguori et al (2016)[69]	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Lin et al (2019)[70]	Y	Y	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y
Zhu et al (2018)[40]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Li et al (2007)[71]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Kassai et al (2016)[72]	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Aydin et al (2021)[61]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Matthyssens et al (2020)[73]	Y	Y	Y	N	Y	U	Y	Y	Y	Y	Y	Y	Y
Tabrizi et al (2015)[66]	Y	Y	Y	U	U	U	Y	N	Y	Y	Y	Y	Y
Batuman et al (2015)[62]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Fernandes et al (2014)[74]	Y	N	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y
Ryu et al (2017)[55]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Wakimizu et al (2009)[76]	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y
Vaezzadeh et al (2011)[67]	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Cumino et al (2013)[78]	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y
Kumar et al (2019)[64]	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Cumino et al (2017)[79]	Y	Y	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y
Fernandes et al (2015)[75]	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y
Eijlers et al (2019)[80]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Total %	100	96	100	3	23	46	100	96	100	100	100	100	100

Y = yes, N = no, U = unclear; JBI critical appraisal checklist for randomised controlled trials: Q1 = Was true randomisation used for assignment of participants to treatment groups? Q2 = Was allocation to treatment groups concealed? Q3 = Were treatment groups similar at baseline? Q4 = Were participants blind to treatment assignment? Q5 = Were those delivering treatment blind to treatment assignment? Q6 = Were outcome assessors blind to treatment assignment? Q7 = Were treatment groups treated identically other than the intervention of interest? Q8 = Was follow-up complete and, if not, were strategies to address incomplete follow-up utilised? Q9 = Were participants analysed in the groups to which they were randomised? Q10 = Were outcomes measured in the same way for treatment groups? Q11 = Were outcomes measured in a reliable way? Q12 = Was appropriate statistical analysis used? Q13 = Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?

Table 2: Critical appraisal results of eligible quasi-randomised controlled trials (quasi-RCTs)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Bartik et al (2018)[60]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sabaq et al (2012)[77]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Total %	100	100	100	100	100	100	100	100	100

Y = yes, N = no, U = unclear; JBI critical appraisal checklist for quasi-experimental studies: Q1 = Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)? Q2 = Were the participants included in any comparisons similar? Q3 = Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest? Q4 = Was there a control group? Q5 = Were there multiple measurements of the outcome both pre and post the intervention/exposure? Q6 = Was follow up complete and, if not, were differences between groups in terms of their follow up adequately described and analysed? Q7 = Were the outcomes of participants included in any comparisons measured in the same way? Q8 = Were outcomes measured in a reliable way? Q9 = Was appropriate analysis used?

of anaesthesia[62] reported higher ratios of post-operative behaviours one week after surgery. One study[77] reported more problems falling asleep, staying asleep and waking up crying in the control group as compared with children in the experimental group. The remaining studies[68,70,73] did not find significant differences between groups but reported a higher incidence of these behaviours in those who received the educational interventions pre-operatively.

Children's and adolescents' post-operative pain

Eight studies[40,54,64,65,68,71,73,80] explored whether the post-operative pain scores differed for participants undergoing educational interventions from those undergoing standard care. Five found lower pre-operative pain scores in the experimental group in the recovery room[65] and post-operatively.[54,64,65,68,71] Of these, three showed statistical differences between groups ($p \leq 0.05$).[54,64,68] Only one study[73] has reported a significant correlation between anxiety levels and pain one week post-operatively ($r = 0.512$; $p = 0.00$).

Children's post-operative pain[40,54,64,65,68,71,73,80] was measured using the Visual Analogue Scale for pain (VAS-p),[65,71] Wong-Baker Scale,[64] the revised Faces Pain Scale (FPS-r),[68,80] the Face, Legs, Activity, Cry, Consolability (FLACC) scale[68,80], the Numeric Rating Scale[40] and the Modified Children's Hospital of Eastern Ontario Pain Score (mCHEOPS).[54] These reliable and validated instruments were self-assessed by the child,[71,73,80] parents[40,73,80] or assessors of the study[54,65,68,80] at different time points – in the recovery room,[54,65,80] at the day-care surgery unit after recovery,[54,64] and up to two weeks post-operatively.[40,65] One study[71] did not detail when the post-operative pain was assessed.

Quality appraisal

The current systematic review included 28 studies, 26 RCTs and two quasi-experimental studies (quasi-RCTs). All the included RCTs answered 'yes' to eight of 13 checklist quality criteria – Q1, Q3, Q7, Q9–Q13 (see Table 1). The two quasi-RCTs answered 'yes' to all checklist criteria (see Table 2). This assessment identified potential methodological weaknesses and sources of bias in the review. First, only one RCT[76] provided information on participants' blinding to treatment assignment; whereas the remaining studies, due to the nature of the intervention, failed to provide information about this criterion. Similarly, studies have failed to guarantee blinding to treatment assignment for personnel delivering treatment[55,56,59–63,65–72,74,75,78,79] and assessing the outcomes.[59,60,63,64,66,69,70,72–76,78,79] This could be explained by the complexity of concealing group allocation, both from participants and those delivering the treatment, when specific interventions such as educational interventions are being used. Also, authors of one study argued the impossibility of organising blinding of outcome assessment due to the lack of funding.[72]

Even though the authors have conducted the appropriate statistical analysis, five studies[70,72–74,76] did not report sufficient data to perform meta-analysis on any outcome. Moreover, meta-analysis of quasi-RCTs was not performed. Therefore, these results as well as the results from all quasi-RCTs[60,77] are presented in a narrative format.

Review findings

Effect of family-centred educational interventions on children's and adolescents' anxiety

Pooled analysis of ten RCTs[56,58,59,63,64,66,67,69,71,75] involving 761 participants favoured the implementation of educational interventions (Figure 2). Moderate-certainty evidence indicates

that educational interventions probably lead to a large reduction in pre-operative paediatric anxiety levels (SMD = -1.02; SE = 0.36; 95% CI [-1.73; -0.32]; p = 0.02). In addition, children and adolescents who participated in a 'single educational Intervention' (SEI) expressed lower anxiety scores than children enrolled in a 'multi-component educational program' (M-CEP) (SMD_{SEI} = -1.29; SE = 0.48; p=0.04; $SMD_{M\text{-}CEP}$ = -0.43; SE = 0.40; p = 0.39).

However, there was high statistical heterogeneity across the individual studies of both subgroups (I^2 = 84.75% and I^2 = 95.41%, respectively). Publication bias was apparent from the funnel plot and Egger's test (p = 0.58) (see Figure 3). Sensitivity analysis was performed by excluding the lowest quality study score[66] ($SMD_{M\text{-}CEP}$ = -0.38; SE = 0.65; p = 0.63; I^2 = 95.1%; $SMD_{overall}$ = -1.08; SE = 0.40; p = 0.028; I2 = 95.50%) and the study that used a different comparator[58] ($SMD_{overall}$ = -0.92; SE = 0.39; p = 0.047; I^2 = 95.00%). The result did not change significantly.

In this review, we have considered the induction of anaesthesia in all studies that reported paediatric anxiety from the holding area up to entering the operating theatre. Pooled analysis of seven RCTs[55,57,61,62,78–80] including 598 participants favoured the use of educational interventions. Moderate-certainty evidence indicates that educational interventions probably lead to a large reduction in paediatric anxiety scores at induction of anaesthesia (SMD = -1.54; SE = 0.62; 95% CI [-2.72; -0.36]; p = 0.046; I^2 = 97.52%; Egger's test = 0.009) (see Figure 4).

Post-operatively, even though four studies[59,64,68,71] have investigated children's and adolescents' anxiety, only three RCTs,[59,64,71] with 301 participants, were included for meta-analysis. Moderate-certainty evidence indicates that educational interventions probably largely reduce post-operative anxiety scores (SMD = -2.33; SE = 0.98; 95% CI [-4.25; -0.40]; p = 0.14; I^2 = 95.92%) (see Figure 5).

According to the results of Egger's test, supported by the funnel plot, there was publication bias in this outcome (p = 0.18) (see Table 3).

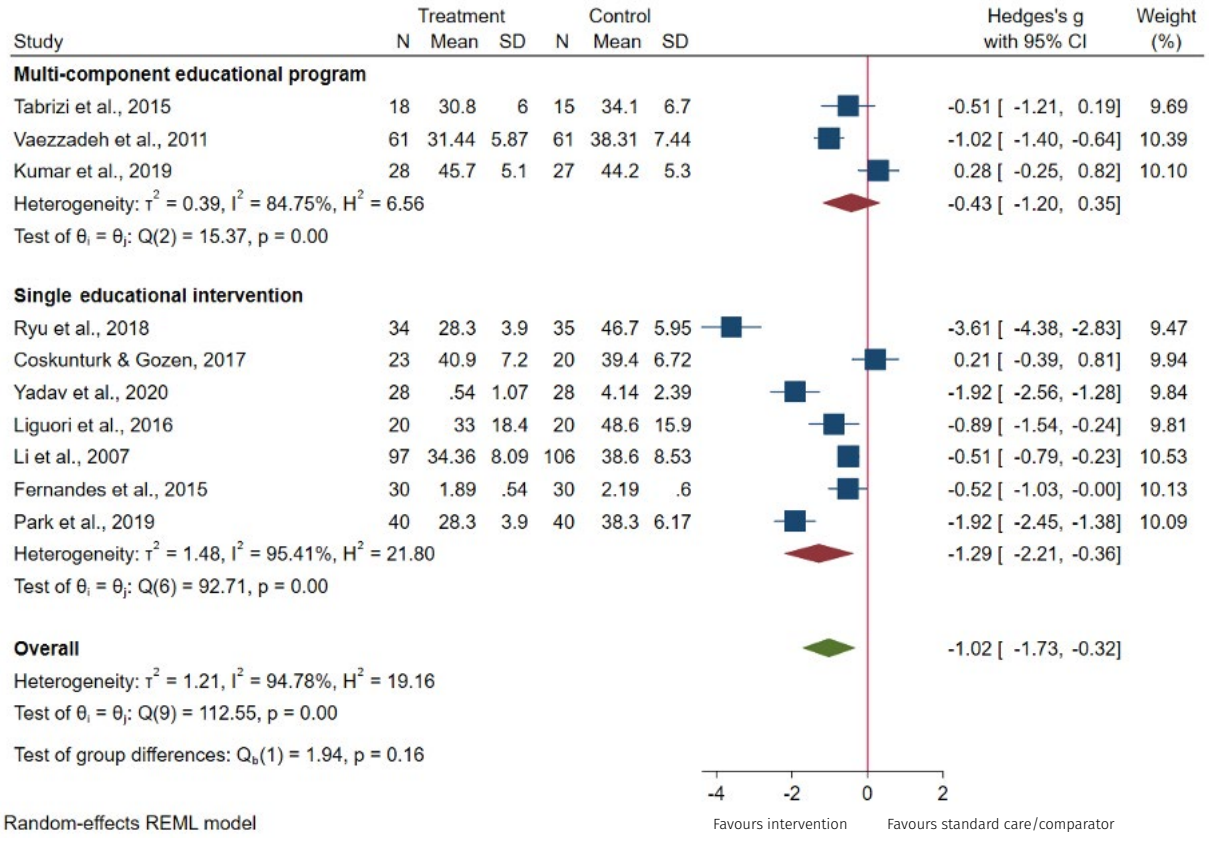

Figure 2: Pre-operative anxiety in children and adolescents – forest plot

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled subgroup analysis (random-effects model) of the multi-component educational programs and single educational intervention's studies.

Effect of family-centred educational interventions on children's and adolescents' behaviour

At the induction of anaesthesia, pooled analysis of two studies,[56,71] with a total sample size of 272 children, favoured the use of educational interventions (SMD = -1.40; SE = 0.67; 95% CI [-2.72; -0.09]; p = 0.28; I^2 = 93.75%) (see Figure 6). Moderate-certainty evidence indicates that educational interventions probably lead to a large improvement of paediatric behaviour at this time point.

Two RCTs[54,68] of 172 children and adolescents were included for meta-analysis to assess the effectiveness of educational interventions on children's and adolescents' post-operative maladaptive behaviours. The findings showed a slightly higher incidence of post-operative behavioural disturbance in the study groups than in the control groups (SMD = 0.12; SE = 0.15; 95% CI [-0.84; 1.09]; p = 0.56; I^2 = 100%) (see Figure 7). However, the shallow quality of the evidence does not allow us to state if educational interventions either improve or exacerbate post-operative behavioural disturbances.

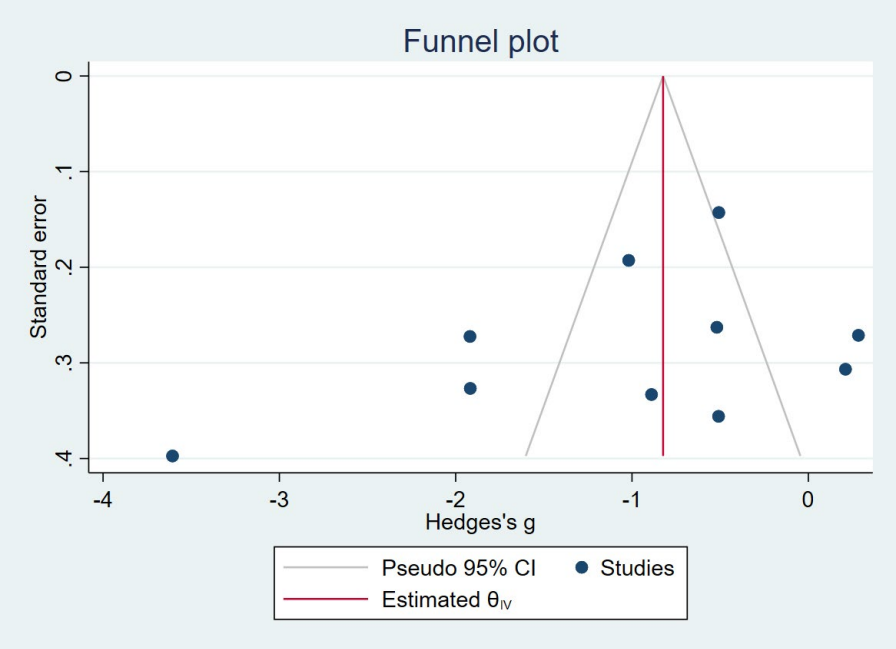

Figure 3: Pre-operative anxiety in children and adolescents – funnel plot

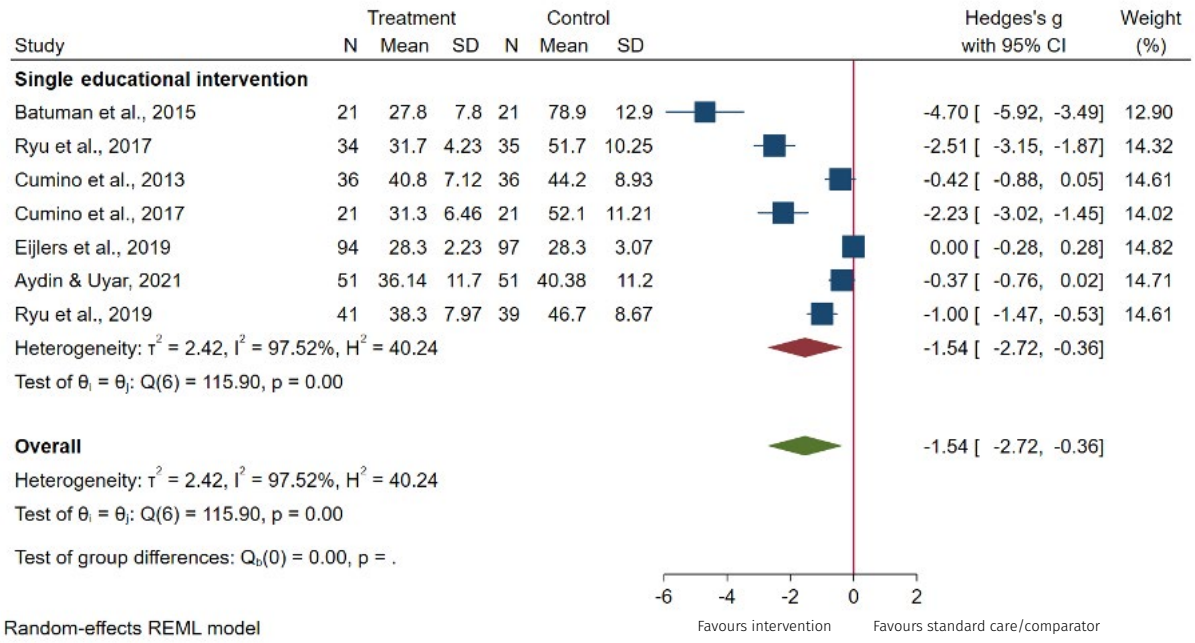

Figure 4: Anxiety at induction of anaesthesia in children and adolescents

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled analysis (random-effects model) of the single educational interventions' studies.

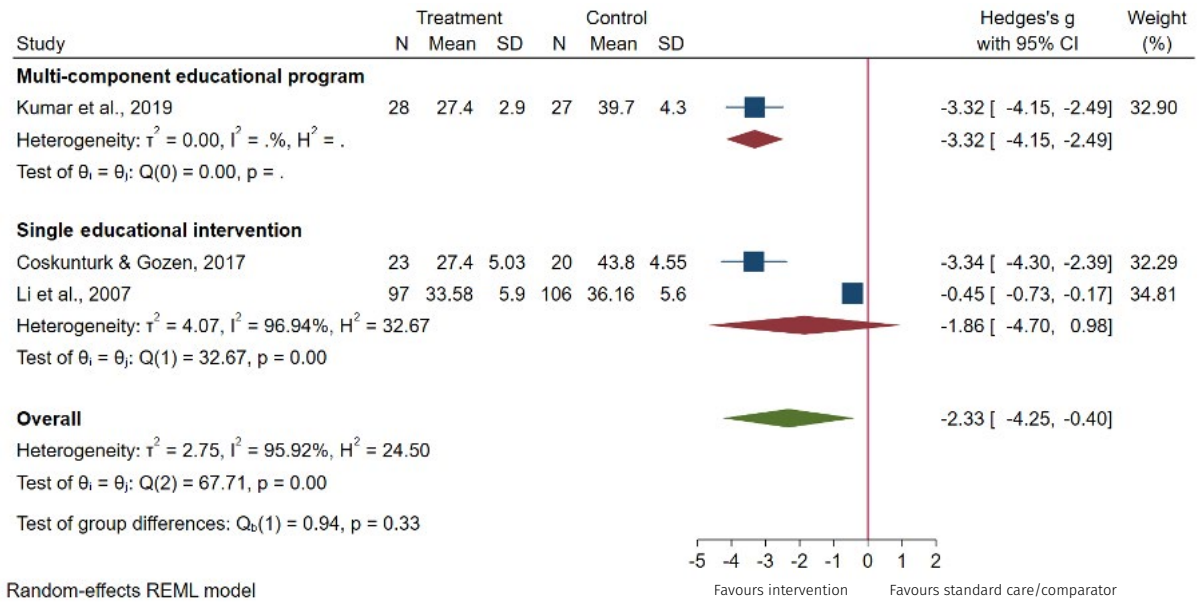

Figure 5: Post-operative anxiety in children and adolescents

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled analysis (random-effects model) of the multi-component educational program and single educational intervention's studies.

Table 3: Post-operative children and adolescents' anxiety – Egger's regression-based test

	Parameter	Coefficient	Std. Error	t	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
Overall	(Intercept)	0.86	0.25	3.39	.18	-2.36	4.08
	SE[c]	-9.22	1.13	-8.19	.08	-23.52	5.09

Random effects meta-regression with the truncated Knapp-Hartung SE adjustment
c. standard error of effect size.

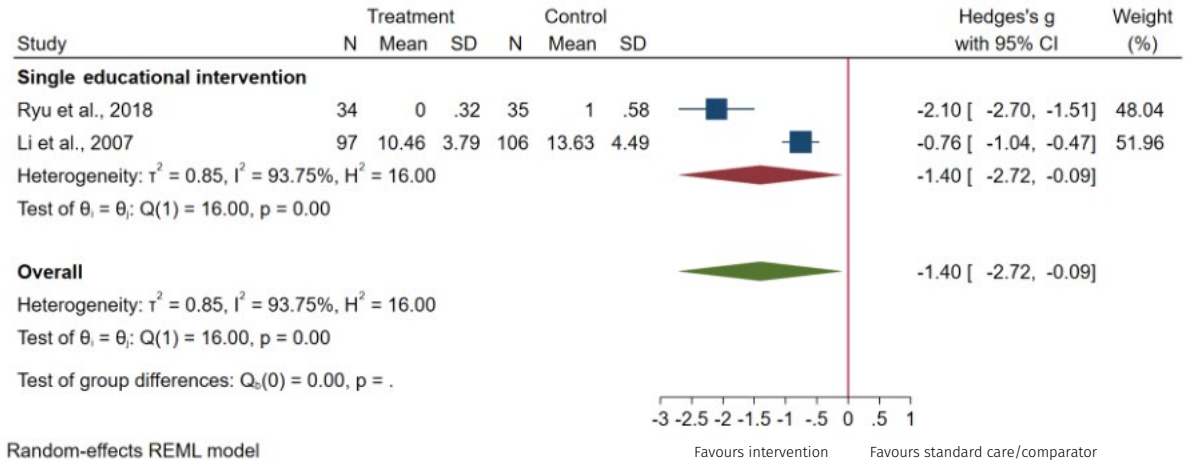

Figure 6: Behaviour at induction of anaesthesia in children and adolescents

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled analysis (random-effects model) of single educational interventions' studies.

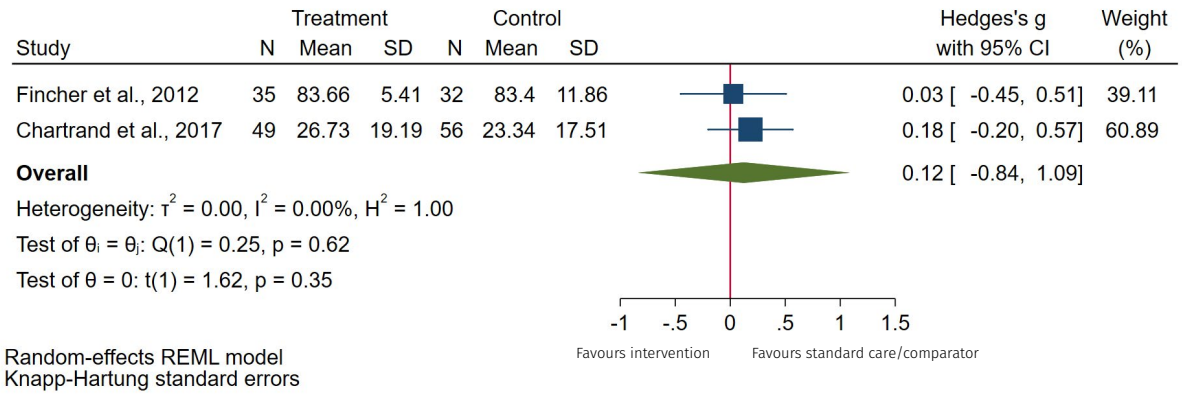

Figure 7: Post-operative behaviour in children and adolescents

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled analysis (random-effects model) of the single educational interventions' studies.

Effect of family-centred educational interventions on children's and adolescents' pain

Four RCTs,[40,64,65,71] with a total sample size of 599 participants, were included in the pooled subgroup analysis to examine the impact of educational interventions on children's post-operative pain (see Figure 8). Overall results suggest nonsignificant differences in post-operative pain scores among participants of both groups (SMD = -0.43; SE = 0.33; 95% CI [-1.05; 0.19] p = 0.28). In addition, the heterogeneity across the individual studies was high (I^2 = 92.17%) and publication bias was present (p = 0.31, Egger's regression test).

Effect of family-centred educational interventions on parental anxiety

A meta-analysis of six RCTs,[59,61,63,64,66,78] with 361 parents, was performed. Moderate-certainty evidence indicates that educational interventions probably lead to a large reduction in pre-operative parental

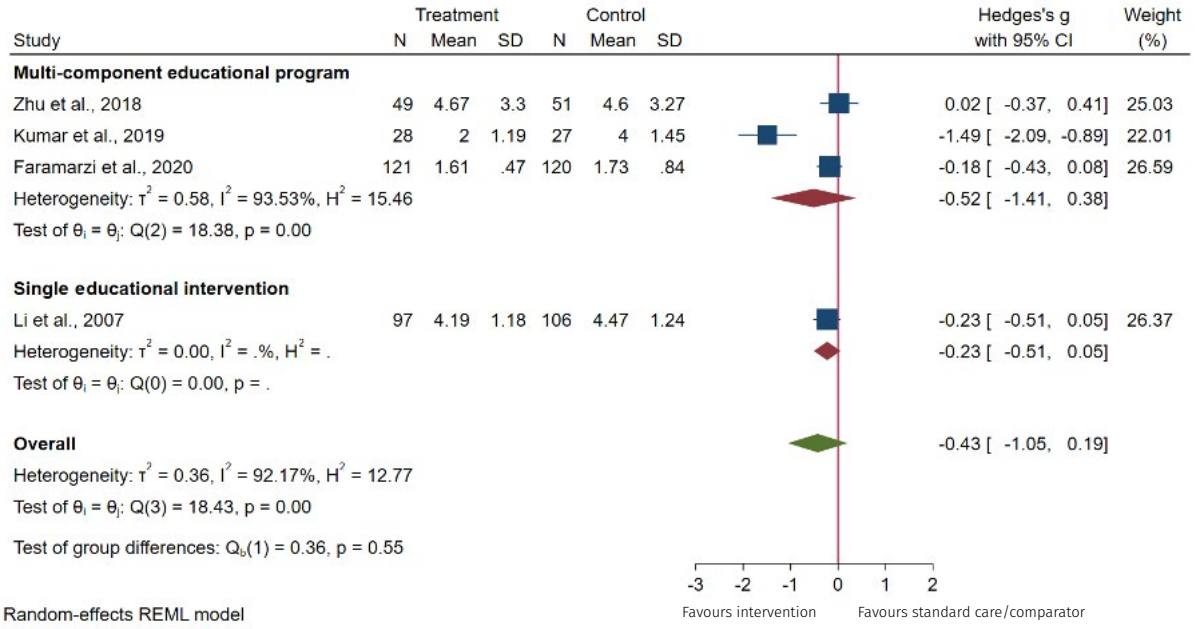

Figure 8: Post-operative pain in children and adolescents

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled subgroup analysis (random-effects model) of the multi-component educational program and single educational interventions' studies.

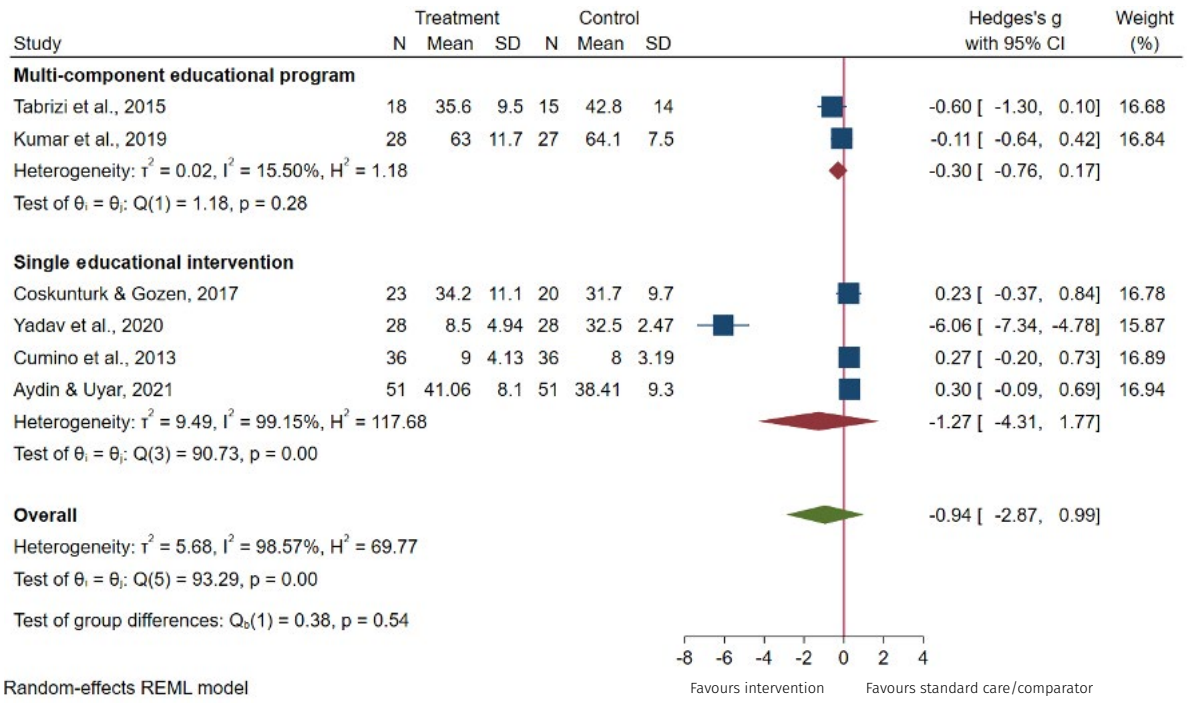

Figure 9: Pre-operative parental anxiety

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled subgroup analysis (random-effects model) of the multi-component educational program and single educational intervention's studies.

anxiety levels (SMD = -0.94; SE = 1.00; 95% CI [-2.87; 0.99]; p = 0.39) (see Figure 9).

Statistical heterogeneity was low in the multi-component educational program subgroup (I^2 = 15.50%) and substantial in the single-educational intervention subgroup (I^2 = 99.15%). Egger's test was statistically significant for absence of publication bias (p = 0.007) (see Figure 10).

At induction of anaesthesia, three RCTs[54,58,80] were included for meta-analysis, with a total sample size of 376 parents (see Figure 11). The evidence is very uncertain regarding the benefits of educational interventions on parental anxiety levels at this time point. In addition, the meta-analysis results (SMD = -0.55; SE = 0.63; p = 0.47; I^2 = 96.69%) were mainly favoured by one study,[58] showing the serious inconsistency across the studies. There was publication bias according to the funnel plot and Egger's regression-based test (p = 0.24).

A meta-analysis of three RCTs,[54,59,64] involving 203 parents, evaluated the impact of educational interventions on post-operative parental anxiety

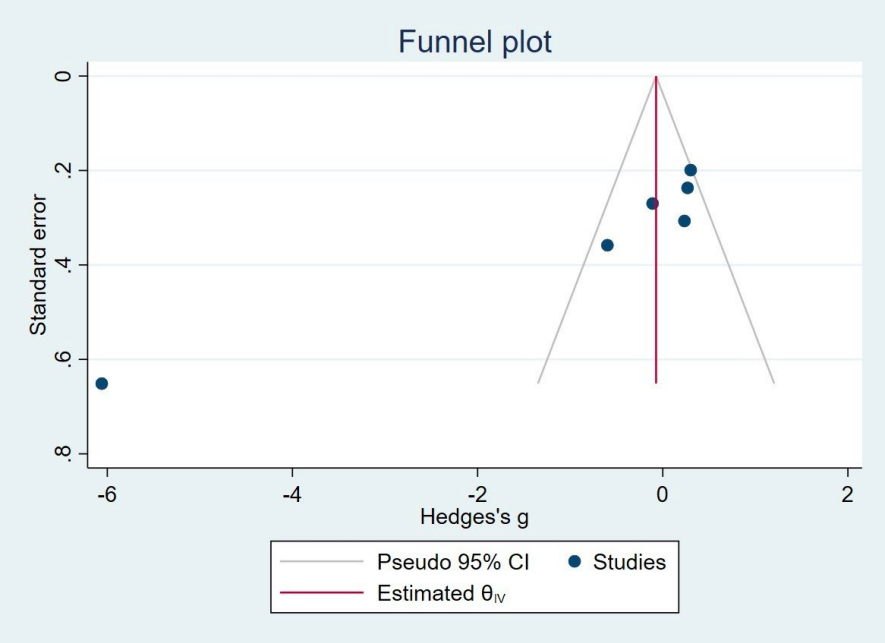

Figure 10: Pre-operative parental anxiety – funnel plot

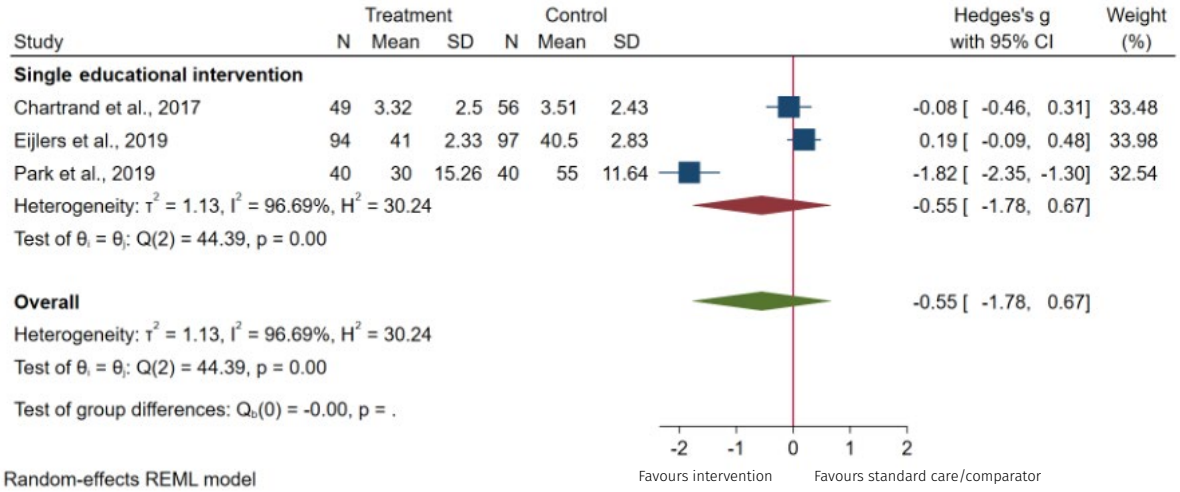

Figure 11: Parental anxiety at induction of anaesthesia

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled analysis (random-effects model) of the single educational intervention's studies.

(see Figure 12). Moderate-certainty evidence indicates that educational interventions probably lead to a large reduction in post-operative parental anxiety levels (SMD = -1.64; SE = 0.72; 95% CI [-3.05; -0.23]; p = 0.15). Nevertheless, the high heterogeneity (I^2 = 93.75%; Figure 12) and the publication bias (p = 0.11; Egger's test) require these results to be carefully interpreted.

Sensitivity analysis was performed for paediatric and parental anxiety levels in the pre-operative period and at the induction of anaesthesia. Studies that used other comparators than standard care[58,61,65,74] were individually excluded; the overall heterogeneity among the studies remained high (I^2>80.00%).

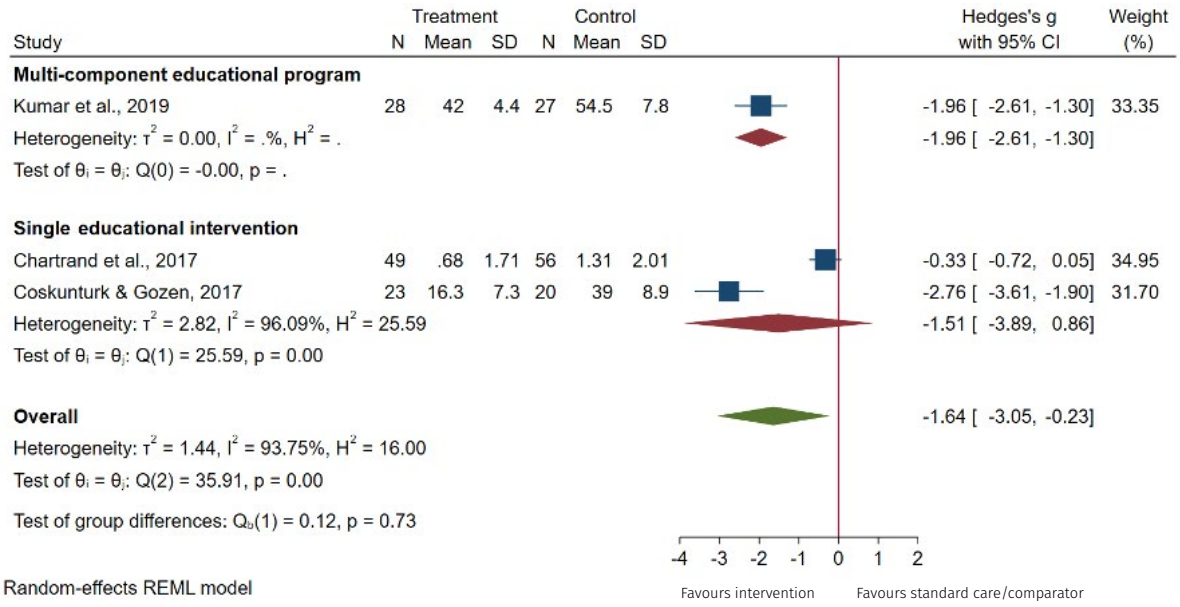

Figure 12: Post-operative parental anxiety

Forest plot showing effect sizes (Hedges' g) and 95% confidence interval (CI) with a pooled subgroup analysis (random-effects model) of the multi-component educational program and single educational intervention's studies.

Discussion

This systematic review of 28 studies yielded a meta-analysis of 21 RCTs[40,54–59,61–68,71,75,78–80] with 1872 children and adolescents and nine RCTs[54,58,59,61,63,64,78,80] with 737 parents over three different outcomes: pain, anxiety and behaviours. To our knowledge, this is the first systematic review presenting an overview of the effect of family-centred educational interventions on children's/adolescents' and parents' outcomes during the perioperative journey.

The results of our meta-analysis suggest that educational interventions can achieve a large reduction in perioperative paediatric anxiety levels, improve paediatric behaviours at induction of anaesthesia and reduce parental pre-operative and post-operative anxiety levels. These results are also supported by the findings of the studies not included in the meta-analysis.

We encountered several difficulties gathering information from the included studies to carry out meta-analyses. The high heterogeneity among the studies at different time points is noticeable and should be considered when judgements about the applicability of these findings in the perioperative context are made. For instance, two major challenges might be the subjective nature of these interventions and the small sample size. Furthermore, the included studies used different types of educational interventions, using video resources, video through virtual reality, games, DVDs, books, leaflets and therapeutic play. Finally, although all studies have used validated and reliable tools, the diverse range of measurement instruments employed and the low number of studies included did not allow us to explore each intervention's effectiveness independently. Considering this, a meta-analysis using a random-effects model was performed to provide valuable information to guide perioperative teams in delivering their care.

Educational interventions effectively reduce pre-operative anxiety of children and adolescents undergoing elective surgery, with statistical differences between groups. This finding is supported by the experimental and quasi-experimental studies included in this review and reinforces the conclusion of the narrative synthesis developed by Copanitsanou and collaborators involving pre-operative education at the paediatric age.[41] However, the moderate quality of evidence (downgraded for serious imprecision, inconsistency and publication bias) does not allow us to make conclusive inferences or recommendations for perioperative practice.

In addition, a systematic review studying the effects of audio–visual interventions on children's anxiety[39] concluded that these effectively reduce children's perioperative anxiety. This finding was supported in the current review, where individual studies in which multimedia was used when educating children and adolescents reported a greater effect on pre-operative anxiety levels.[56,58,69]

In contrast to the findings reported by Kim et al.[43] in which children benefited more from pre-operative technology-based preparation programs, our study found that children and adolescents who participated in a single educational intervention expressed lower pre-operative anxiety scores than those enrolled in a multi-component educational program. This is possibly related to the family-centredness and educational components of our study.

Insufficient data on the paediatric population from the different studies did not allow us to stratify the results by age (children and adolescents). Although adolescents were included in the eligibility criteria of this review, only three of the 28 included studies had adolescents in their population sample,[40,64,72] hence the need for more primary studies.[81]

Additionally, the findings from our review suggest that implementing educational interventions may be useful to increase paediatric compliance at induction of anaesthesia but not in reducing post-operative behavioural disturbances in children and adolescents. With only two relatively small studies, the estimate was not precise enough to determine the direction of effect; therefore, we are uncertain regarding the effectiveness of these interventions on children's and adolescents' post-operative maladaptive behaviours. Moreover, educational interventions do not seem to affect the incidence of emergence delirium symptoms in the recovery area.

In our narrative synthesis, children and adolescents benefited from educational interventions to reduce post-operative pain intensity without statistically significant differences. Evidence supports that children and adolescents with higher levels of anxiety prior to surgery tend to exhibit greater intensity of post-operative pain.[82] However, only one study[73] has reported a significant correlation between anxiety levels and pain intensity one week post-operatively.

Regarding parental anxiety, the results from this review suggest that the implementation of educational interventions might provide a valuable alternative to reduce parental anxiety, and this concurs with findings from the study conducted by Copanitsanou and collaborators.[41] Multi-component educational programs,[64,66] with

pre-operative tours, pamphlets and booklets, were also associated with a greater reduction in pre-operative anxiety levels, corroborating the results of the systematic review undertaken by Kim and collaborators.[43]

Strengths and limitations

This systematic review and meta-analysis has multiple strengths, including a wide range of data collection from different databases and studies from various countries, which enhance generalisability to our results. However, we are aware that our research may have several limitations that contributed to the high heterogeneity of the overall results. We speculate that these limitations were linked with insufficient studies at specific evaluation time points and studied outcomes, small study sample sizes, the wide range of participants' ages, and differences in measurement instruments across the studies. In addition, no differentiation was made between 'self' and 'observed' assessments. Since we have included studies only written in English, Spanish and Portuguese, language bias was also present. In addition, we must assume as a limitation the lack of the terms 'disorders', 'sleeping' and 'eating' related to the post-operative maladaptive behaviours in our search strategy. Finally, this review did not explore the content and type of methodologies and materials used due to the lack of studies.

Conclusions

The findings from this systematic review provide further evidence to improve perioperative practice in paediatric settings, indicating the probable benefits of implementing family-centred educational interventions to reduce perioperative family anxiety and improve paediatric behaviours at induction of anaesthesia. However, the diversity of measurement instruments used among the studies makes performing a meta-analysis and producing more robust data difficult.

Implications for practice

Family-centred education can lead to reduced anxiety levels in children, adolescents and parents, and improved compliance at induction of anaesthesia, in comparison with standard or other preparation methods. Children and adolescents seem to benefit more from single educational interventions, whereas parents demonstrate better health outcomes with multi-component educational programs. Therefore, tailored family-centred education is essential to meet children's, adolescents' and parents' needs.

Implications for future research

This review has found possible benefits of educational interventions for the family at the different stages of the perioperative journey. If further comparative effectiveness trials aim to determine whether or not educational interventions are effective, these should consider a larger sample size. In addition, further studies with adolescents and parents are needed to understand the impact of educational interventions on the management of pain and anxiety during the perioperative journey.

Note: This review will contribute towards a MSc in Paediatric Nursing for the first author, IE.

Competing interest

The authors declare no conflict of interest.

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Effectiveness of family-centred educational interventions for anxiety, pain and behaviours of children and adolescents and anxiety of their parents during the perioperative journey: A systematic review and meta-analysis

Supplement 1: Search strategy

MEDLINE (via PubMed)

Search conducted on 13 April 2021.

Search	Query	Records retrieved
#1	adolescen*[Title/Abstract] OR teen*[Title/Abstract] OR youth[Title/Abstract] OR child*[Title/Abstract] OR paediatric*[Title/Abstract] OR pediatric*[Title/Abstract] OR parent*[Title/Abstract] OR mother*[Title/Abstract] OR father*[Title/Abstract] OR "early adulthood"[Title/Abstract] OR "young adulthood"[Title/Abstract] OR Family[Title/Abstract] OR Caregiver*[Title/Abstract] OR Care-giver[Title/Abstract] OR Carer*[Title/Abstract]	2 942 362
#2	Surg*[Title/Abstract] OR "pre-operative"[Title/Abstract] OR Pre-operative[Title/Abstract] OR Perioperative[Title/Abstract] OR post-operative[Title/Abstract]	2 358 782
#3	"audiovisual aids"[Title/Abstract] OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session"[Title/Abstract] OR DVD OR "digital versatile disc"[Title/Abstract] OR video* OR leaflet* OR "non-pharmacological intervention"[Title/Abstract] OR "nonpharmacological intervention"[Title/Abstract] OR "Complementary Therapy"[Title/Abstract] OR "family centered care"[Title/Abstract] OR "family centred care"[Title/Abstract]	2 095 378
#4	pain*[Title/Abstract] OR anxiety[Title/Abstract] OR behaviour[Title/Abstract] OR behavior[Title/Abstract] OR STAI[Title/Abstract] OR "FLACC"[Title/Abstract] OR "visual analog scale"[Title/Abstract]	1 784 997
#5	"Adolescent"[Mesh] OR "Minors"[Mesh] OR "Child"[Mesh:NoExp] OR "Child, Preschool"[Mesh] OR "Family"[Mesh:NoExp] OR "Parents"[Mesh] OR "Mothers"[Mesh] OR "Fathers"[Mesh] OR "Caregivers"[Mesh:NoExp]	3 209 023
#6	"Elective Surgical Procedures"[Mesh] OR "Surgical Procedures, Operative"[Mesh:NoExp] OR "pre-operative care"[Mesh] OR "perioperative care"[Mesh] OR "post-operative care"[Mesh]	217 009
#7	"Hypermedia"[Mesh] OR "Education"[Mesh:NoExp] OR "Teaching"[Mesh:NoExp] OR "Teaching Materials"[Mesh:NoExp] OR "Audiovisual Aids"[Mesh:NoExp] OR "Multimedia"[Mesh] OR "Videotape Recording"[Mesh] OR "Books"[Mesh:NoExp] OR "Pamphlets"[Mesh:NoExp] OR "Complementary Therapies"[Mesh:NoExp]	117 172
#8	"Pain"[Mesh:NoExp] OR "Pain, Post-operative"[Mesh:NoExp] OR "Anxiety"[Mesh:NoExp] OR "Acute Pain"[Mesh] OR "Behavior"[Mesh:NoExp]	288 558
#9	#1 OR #5	4 711 539
#10	#2 OR #6	2 414 594
#11	#3 OR #7	2 110 674
#12	#4 OR #8	1 855 885
#13	#9 AND #10 AND #11 AND #12	4751
#14	Filters: Limited to from 2007/01/01	3219
#15	Languages: English, Spanish and Portuguese	3103

CINAHL (via EBSCOhost)

Search conducted on 13 April 2021.

Search	Query	Records retrieved
#1	TI (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*) OR AB (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*)	227 285
#2	TI (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative) OR AB (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative)	255 490
#3	TI ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care") OR AB ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care")	78 290
#4	TI (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale") OR AB (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale")	274 223
#5	MM "Adolescence" OR MM "Child" OR MM "Child, Preschool" OR MM "Minors (Legal)" OR MM "Family" OR MM "Parents" OR MM "Mothers" OR MM "Fathers" OR MM "Caregivers"	86 873
#6	MM "Pre-operative care" OR MM "Surgery, Elective" OR MM "Post-operative care" OR MM "Perioperative care" OR MM "Ambulatory Surgery"	28 793
#7	MM "hypermedia" OR MM "multimedia" OR MM "education" OR MM "teaching" OR MM "teaching materials" OR MM "pre-operative education" OR MM "Teaching: Pre-operative (Iowa NIC)" OR MM "Teaching materials, clinical" OR MM "books" OR MM "electronic books" OR MM "print materials" OR MM "pamphlets" OR MM "Alternative Therapies"	37 141
#8	MM "Post-operative pain" OR MM "Pain" OR MM "Anxiety" OR MM "Behavior"	88 948
#9	#1 OR #5	973 825
#10	#2 OR #6	487 506
#11	#3 OR #7	426 076
#12	#4 OR #8	577 904
#13	#9 AND #10 AND #11 AND #12	754
#14	Filters: Limited to from 2007/01/01	564
#15	Languages: English, Spanish and Portuguese	525

Cochrane Central Register of Controlled Trials (via EBSCOhost)

Search conducted on 13 April 2021.

Search	Query	Records retrieved
#1	TI (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*) OR AB (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*)	227 285
#2	TI (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative) OR AB (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative)	255 490
#3	TI ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care") OR AB ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care")	78 290
#4	TI (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale") OR AB (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale")	274 223
#5	MH "Adolescent" OR "Minors" OR "Child" OR "Child, Preschool" OR "Family" OR "Parents" OR "Mothers" OR "Fathers" OR "Caregivers"	131 505
#6	MH "Elective Surgical Procedures" OR "Surgical Procedures, Operative" OR "pre-operative care" OR "perioperative care" OR "post-operative care"	6975
#7	MH "Hypermedia" OR "Education" OR "Teaching" OR "Teaching Materials" OR "Audiovisual Aids" OR "Multimedia" OR "Videotape Recording" OR "Books" OR "Pamphlets" OR "Complementary Therapies"	3541
#8	MH "Pain" OR "Pain, Post-operative" OR "Anxiety" OR "Acute Pain" OR "Behavior"	5416
#9	#1 OR #5	308 919
#10	#2 OR #6	256 539
#11	#3 OR #7	79 763
#12	#4 OR #8	275 234
#13	#9 AND #10 AND #11 AND #12	642
#14	Filters: Limited to from 2007/01/01	549
#15	Languages: English, Spanish and Portuguese	249

PsycINFO (via EBSCOhost)

Search conducted on 13 April 2021.

Search	Query	Records retrieved
#1	TI (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*) OR AB (adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood" OR Family OR Caregiver* OR Care-giver OR Carer*)	1 212 659
#2	TI (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative) OR AB (Surg* OR "pre-operative" OR Pre-operative OR Perioperative OR post-operative)	53 770
#3	TI ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care") OR AB ("audiovisual aids" OR book* OR multimedia* OR hypermedia OR pamphlet* OR education OR "teaching session" OR DVD OR "digital versatile disc" OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care" OR "family centred care")	612 500
#4	TI (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale") OR AB (pain* OR anxiety OR behaviour OR behavior OR STAI OR "FLACC" OR "visual analog scale")	1 002 197
#5	MA "Adolescent" OR "Minors" OR "Child" OR "Child, Preschool" OR "Family" OR "Parents" OR "Mothers" OR "Fathers" OR "Caregivers"	416 167
#6	MA "Elective Surgical Procedures" OR "Surgical Procedures, Operative" OR "pre-operative care" OR "perioperative care" OR "post-operative care"	1944
#7	MA "Hypermedia" OR "Education" OR "Teaching" OR "Teaching Materials" OR "Audiovisual Aids" OR "Multimedia" OR "Videotape Recording" OR "Books" OR "Pamphlets" OR "Complementary Therapies"	62 902
#8	MA "Pain" OR "Pain, Post-operative" OR "Anxiety" OR "Acute Pain" OR "Behavior"	309 216
#9	#1 OR #5	1 376 746
#10	#2 OR #6	54 103
#11	#3 OR #7	649 702
#12	#4 OR #8	1 137 403
#13	#9 AND #10 AND #11 AND #12	570
#14	Filters: Limited to from 2007/01/01	344
#15	Languages: English, Spanish and Portuguese	333

SciELO

Search conducted on 9 April 2021.

Search	Query	Records retrieved
#1	(ti:(adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood")) OR (ab:(adolescen* OR teen* OR youth OR child* OR paediatric* OR pediatric* OR parent* OR mother* OR father* OR "early adulthood" OR "young adulthood"))	1307
#2	(ti:(Surgery OR "pre-operative preparation" OR "pre-operative preparation" OR surgical)) OR (ab:(Surgery OR "pre-operative preparation" OR "pre-operative preparation" OR surgical))	36 133
#3	(ti:("audiovisual aids" OR book* OR multimedia* OR pamphlet* OR education OR "teaching session" OR DVD OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care")) OR (ab:("audiovisual aids" OR book* OR multimedia* OR pamphlet* OR education OR "teaching session" OR DVD OR video* OR leaflet* OR "non-pharmacological intervention" OR "nonpharmacological intervention" OR "Complementary Therapy" OR "family centered care"))	842
#4	(ti:(pain* OR anxiety OR behaviours OR behavior)) OR (ab:(pain* OR anxiety OR behaviours OR behavior))	54 029
#6	#1 AND #2 AND #3 AND #4	0
#7	Filters: Limited to from 2007/01/01 Languages: English, Spanish and Portuguese	0

* As no results were found for this search (at the time, the database was having problems), the authors tried a simpler search strategy.

SciELO

Search conducted on 15 April 2021.

Search	Query	Records retrieved
#1	(child* AND educat* AND anxiety)	117
#7	Filters: Limited to from 2007/01/01 Languages: English, Spanish and Portuguese	102

OpenGrey

Search conducted on 3 April 2021.

Search	Query	Records retrieved
#1	Intervention child surgery	1
#2	Filters: Limited to from 2007/01/01 Languages: English, Spanish and Portuguese	1

Open Access Theses and Dissertations

Search conducted on 3 April 2021.

Search	Query	Records retrieved
#1	intervention AND child AND surgery	58
#2	Filters: Limited to from 2007/01/01 Languages: English, Spanish and Portuguese	32

Repositório Científico de Acesso Aberto em Portugal (RCAAP)

Search conducted on 9 April 2021.

Search	Query	Records retrieved
#1	Família AND criança AND ansiedade (field: discussion)	177
#2	Filters: Limited to from 2007/01/01 Languages: English, Spanish and Portuguese	155

Effectiveness of family-centred educational interventions for anxiety, pain and behaviours of children and adolescents and anxiety of their parents during the perioperative journey: A systematic review and meta-analysis

Supplement 2: Studies ineligible following full-text review

Study	Reason for exclusion
1. Adams HA. A perioperative education program for paediatric patients and their parents. AORN J. 2011;93(4):472–81.	Ineligible study design (literature review)
2. Akinci SB, Köse EA, Ocal T, Aypar U. The effects of maternal presence during anesthesia induction on the mother's anxiety and changes in children's behavior. Turk J Pediatr. 2008;50(6):566–71.	Ineligible intervention
3. Álvarez GN, Gómez PV, Siles HA, Gracia RJ. Psychoprophylaxis in elective paediatric general surgery: Do audiovisual tools improve perioperative anxiety in children and their families? Cir Pediatr. 2017;30(4):216–20.	Ineligible study design, intervention and outcomes only for children
4. Arnon Z, Hanan H, Mogilner J. The effect of a hypnotic-based animated video on stress and pain reduction in pediatric surgery. Int J Clin Exp Hypn. 2018;66(2):123–33.	Intervention and outcomes only for children
5. Baghele A, Dave N, Dias R, Shah H. Effect of pre-operative education on anxiety in children undergoing day-care surgery. Indian J Anaesth. 2019;63(7):565–70.	Intervention and outcomes only for children
6. Bailey KM, Bird SJ, McGrath PJ, Chorney JE. Preparing parents to be present for their child's anesthesia induction: A randomized controlled trial. Anesth Analg. 2015;121(4):1001–10.	Ineligible intervention
7. Berghmans J, Weber F, van Akoleyen C, Utens E, Adriaenssens P, Klein J et al. Audiovisual aid viewing immediately before pediatric induction moderates the accompanying parents' anxiety. Paediatr Anaesth. 2012;22(4):386–92.	Ineligible population. Dr JB was contacted by email (31.7% of the study sample were under three years old)
8. Book F, Goedeke J, Poplawski A, Muensterer OJ. Access to an online video enhances the consent process, increases knowledge and decreases anxiety of caregivers with children scheduled for inguinal hernia repair: A randomized controlled study. J Pediatr Surg. 2020;55(1):18–28.	Ineligible intervention
9. Chorney JM, Kain ZN. Behavioral analysis of children's response to induction of anesthesia. Anesth Analg. 2009;109(5):1434–40.	Ineligible intervention, study design
10. Chorney JM, Tan ET, Kain ZN. Adult-child interactions in the postanesthesia care unit: behavior matters. Anesthesiology. 2013;118(4):834–41.	Ineligible intervention
11. Crandall M, Lammers C, Senders C, Braun JV, Savedra M. Children's pre-operative tonsillectomy pain education: Clinical outcomes. Int J Pediatr Otorhinolaryngol. 2008;72(10):1523–33.	Intervention and outcomes only for children
12. Dalley JS, McMurtry CM. Teddy and I get a check-up: A pilot educational intervention teaching children coping strategies for managing procedure-related pain and fear. Pain Res Manag. 2016;2016(0):4383967.	Intervention and outcomes only for children
13. De Armendi A, Gillaspy S, Shukry M, Martinez M, Cure J. Spanish video in anesthesia as an uncertainty and anxiety reducer tool in Spanish speaking parents. Br J Anaesth. 2012;108:ii286-ii7.	Abstract only

Study	Reason for exclusion
14. Eijlers R, Legerstee JS, Dierckx B, Staals LM, Berghmans J, van der Schroeff MP et al. Development of a virtual reality exposure tool as psychological preparation for elective pediatric day care surgery: methodological approach for a randomized controlled trial. JMIR Res Protoc. 2017;6(9):e174.	Ineligible study design (protocol)
15. Festini F, Liguori S, Stacchini M, Ciofi D, Giusti F, Olivini N et al. Effectiveness of a new method to reduce pre-operative anxiety in children: Randomised controlled trial. Arch Disease Child. 2014;99(0):A79.	Abstract only
16. Fincher W, Shaw J, Ramelet A-S. Pre-operative preparation can ease children's and parents' anxieties. Nurs Child Young People. 2012;24(4):11.	Abstract only
17. Fortier MA, Blount RL, Wang SM, Mayes LC, Kain ZN. Analysing a family-centred pre-operative intervention programme: A dismantling approach. Br J Anaesth. 2011;106(5):713–8.	Ineligible study design
18. Fortier MA, Bunzli E, Walthall J, Olshansky E, Saadat H, Santistevan R et al. Web-based tailored intervention for preparation of parents and children for outpatient surgery (WebTIPS): Formative evaluation and randomized controlled trial. Anesth Analg. 2015;120(4):915–22.	Ineligible population. Dr MF was contacted by email. Did not receive a response regarding the study sample under three years old until the 26 July 2021, the date when the authors started the findings review.
19. Hamza Taha SM, Hassan El-Sayed RE. Effect of an educational comic story about pre-operative orientation on information and anxiety level of children undergoing surgery. Clin Nurs Res. 2021;30(6):771–779.	Intervention and outcomes only for children
20. Hee H, Lim E, Tan Q, Bao Z, Loh K, Hee HI et al. Effect of pre-operative education on behaviour of children during induction of anaesthesia: A randomised clinical trial of efficacy. Anaesth Intensive Care. 2012;40(5):795–802.	Intervention and outcomes only for children
21. Helgadóttir HL, Wilson ME. A randomized controlled trial of the effectiveness of educating parents about distraction to decrease post-operative pain in children at home after tonsillectomy. Pain Manag Nurs. 2014;15(3):632–40.	Ineligible intervention
22. Hilly J, Hörlin AL, Kinderf J, Ghez C, Menrath S, Delivet H, et al. Pre-operative preparation workshop reduces post-operative maladaptive behavior in children. Paediatr Anaesth. 2015;25(10):990–8.	Ineligible study design
23. Jang O. Efficacy of two screen-based approaches to relieving pre-operative anxiety in young children: preliminary data. Boston: Boston University; 2017.	Ineligible intervention
24. Jang O, Rodriguez S, Caruso T, Hernandez M, Simons L. A bed-mounted screen-based approach to managing pre-operative anxiety in young children undergoing mask induction of anesthesia. J Pain. 2017;18(Suppl 1):S42-S.	Abstract only
25. Ji L, Zhang X, Fan H, Han M, Yang H, Tang L et al. drawMD APP-aided pre-operative anesthesia education reduce parents' anxiety and improve satisfaction. Patient Educ Couns. 2016;99(2):265–70.	Methodology lacked rigour. Allocation to treatment groups unclear, treatment delivery blind to treatment assignment unclear, outcomes assessors were not blind to treatment allocation, unclear the appropriate statistical analysis used.
26. Jin Y, Jiang A, Jiang W, Wu W, Ye L, Kong X, et al. Self-produced audio-visual animation introduction alleviates pre-operative anxiety in pediatric strabismus surgery: a randomized controlled study. BMC Ophthalmol. 2021;21(1):163.	Ineligible intervention
27. Kain ZN, Caldwell-Andrews A, Mayes L, Weinberg M, Wang S-M, MacLaren J et al. Family-centered preparation for surgery improves perioperative outcomes in children. Anesthesiology. 2007;106(1):65–74.	Ineligible population
28. Kain ZN, Fortier MA, Chorney JM, Mayes L. Web-based tailored intervention for preparation of parents and children for outpatient surgery (WebTIPS): development. Anesth Analg. 2015;120(4):905–14.	Ineligible study design

Study	Reason for exclusion
29. Kerimoglu B, Neuman A, Paul J, Stefanov DG, Twersky R. Anesthesia induction using video glasses as a distraction tool for the management of pre-operative anxiety in children. Anesth Analg. 2013;117(6):1373–9.	Ineligible intervention
30. Khan S, Tumin D, King A, Rice J, Jatana KR, Tobias JD et al. Utilization of a post-operative adenotonsillectomy teaching video: A pilot study. Int J Pediatr Otorhinolaryngol. 2017;102:76-9.	Intervention and outcomes only for parents
31. Landier M, Villemagne T, Le Touze A, Braïk K, Meignan P, Cook AR et al. The position of a written document in pre-operative information for pediatric surgery: A randomized controlled trial on parental anxiety, knowledge, and satisfaction. J Pediatr Surg. 2018;53(3):375–80.	Intervention and outcomes only for parents
32. Lee J, Lee J, Lim H, Son JS, Lee JR, Kim DC et al. Cartoon distraction alleviates anxiety in children during induction of anesthesia. Anesth Analg. 2012;115(5):1168–73.	Ineligible intervention
33. Lerwick J. The impact of child-centered play therapy on anxiety levels in pre-neurosurgical pediatric patients. Oregon: Oregon State University; 2011.	Ineligible intervention
34. Li HC, Lopez V. Effectiveness and appropriateness of therapeutic play intervention in preparing children for surgery: A randomized controlled trial study. J Spec Pediatr Nurs. 2008;13(2):63–73.	Duplicate study sample
35. Li HC, Lopez V, Lee TL. Psychoeducational preparation of children for surgery: The importance of parental involvement. Patient Educ Couns. 2007;65(1):34–41.	Duplicate study sample
36. Li HCW. Evaluating the effectiveness of pre-operative interventions: The appropriateness of using the Children's Emotional Manifestation Scale. J Clin Nurs. 2007;16(10):1919–26.	Intervention and outcomes only for children
37. Liu CY, Xu L, Zang YL. Effectiveness of audiovisual interventions on stress responses in adolescents with ENT surgery in hospital: Randomized controlled trial protocol. J Adv Nurs. 2014;70(6):1414–24.	Ineligible study design (protocol)
38. Macindo JR, Macabuag KR, Macadangdang CM, Macaranas MV, Macarilay MJ, Madriñan NN et al. 3-D storybook: Effects on surgical knowledge and anxiety among four- to six-year-old surgical patients. AORN J. 2015;102(1):62.e1–10.	Intervention and outcomes only for children
39. Martin SR, Chorney JM, Tan ET, Fortier MA, Blount RL, Wald SH et al. Changing healthcare providers' behavior during pediatric inductions with an empirically based intervention. Anesthesiology. 2011;115(1):18–27.	Ineligible intervention
40. Nair T, Choo CSC, Abdullah NS, Lee S, Teo LLE, Chen Y, et al. Home-Initiated-Programme-to-Prepare-for-Operation: evaluating the effect of an animation video on perioperative anxiety in children: a randomised controlled trial. Eur J Anaesthesiol. 2021;38(8):880–7.	Intervention and outcomes only for children
41. Nilsson E, Svensson G, Frisman GH. Picture book support for preparing children ahead of and during day surgery. Nurs Child Young People. 2016;28(8):30–5.	Ineligible study design (descriptive intervention study).
42. Piper KN, Baxter KJ, Wetzel M, McCracken C, Travers C, Slater B et al. Provider education decreases opioid prescribing after pediatric umbilical hernia repair. J Pediatr Surg. 2020;55(7):1319–23.	Ineligible population
43. Rehman J, Rempel G, Williams E, Meakins L, Bauman M, Massicotte P et al. Development and evaluation of a pre-operative preparation program for parents of children undergoing fontan surgery. Can J Cardiol. 2020;36(10):S26.	Abstract only
44. Sakizci Uyar B, Polat R, Bolat M, Donmez A. Which is good for pre-operative anxiety? Midazolam, video games or teaching with cartoons: A randomised trial. Eur J Anaesthesiol. 2021;38(7):744–50.	Intervention and outcomes only for children
45. Sekhavatpour Z, Khanjani N, Reyhani T, Ghaffari S, Dastoorpoor M. The effect of storytelling on anxiety and behavioral disorders in children undergoing surgery: A randomized controlled trial. Health Med Ther. 2019;10:61-8.	Intervention and outcomes only for children

Study	Reason for exclusion
46. Seyedhejazi M, Sharabiani BA, Davari A, Taghizadieh N. A comparison of pre-operative psychological preparation with midazolam premedication to reduce anxiety in children undergoing adenotonsillectomy. Afr J Paediatr Surg. 2020;17(1–2):10–4.	Intervention and outcomes only for children
47. Shaheen A, Nassar O, Khalaf I, Kridli SA, Jarrah S, Halasa S. The effectiveness of age-appropriate pre-operative information session on the anxiety level of school-age children undergoing elective surgery in Jordan. Int J Nurs Pract. 2018;24(3):e12634.	Intervention and outcomes only for children
48. Shoja M, Heshmati Nabavi F, Ramezani M, Saki A. Effect of a pre-operative preparation program on anxiety in school-age children undergoing surgery using a factorial design. J Evid Based Healthc. 2018;7(4):30–7.	Intervention and outcomes only for children
49. Teixeira EMD, de Figueiredo MCB. The child's pre-operative experience in a planned surgery. Revista de Enfermagem Referência. 2009(9):7–14.	Ineligible study design (qualitative study)
50. Tomaszek L, Cepuch G, Fenikowski D. Influence of pre-operative information support on anxiety, pain and satisfaction with post-operative analgesia in children and adolescents after thoracic surgery: A randomized double-blind study. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2019;163(2):172–8.	Ineligible intervention
51. Tunney AM. A study to access the effectiveness of the provision of written material in the form of a storybook in lessening anxiety in children aged 5–11 years undergoing tonsillectomy and adenoidectomy. Ulster: University of Ulster; 2014.	Intervention and outcomes only for children
52. Tural Buyuk E, Bolişik B. An analysis of the anxiety levels of mothers who participate in education and therapeutic games about their children's surgeries. J Perianesth Nurs. 2018;33(3):290–5.	Intervention and outcomes only for mothers
53. Türk E, Güven A, Karaca F, Edirne Y, Karaca I. Using the parents' video camera for the follow-up of children who have undergone hypospadias surgery decreases hospital anxiety of children. J Pediatr Surg. 2013;48(11):2332–5.	Ineligible intervention
54. Verschueren S, van Aalst J, Bangels AM, Toelen J, Allegaert K, Buffel C et al. Development of CliniPup, a serious game aimed at reducing perioperative anxiety and pain in children: Mixed methods study. JMIR Serious Games. 2019;7(2):e12429.	Ineligible study design
55. Volpato Broering C, Duarte de Souza C, Kaszubowski E, Aparecida Crepaldi M. Efeitos de Preparações Psicológicas Pré-Cirúrgicas sobre o Estresse e a Ansiedade de Meninos e Meninas [Effects of pre-surgical psychological preparations on stress and anxiety in boys and girls]. Acta Colom de Psicol. 2018;21(1):228–38.	Intervention and outcomes only for children
56. West N, Christopher N, Stratton K, Görges M, Brown Z. Reducing pre-operative anxiety with Child Life preparation prior to intravenous induction of anesthesia: A randomized controlled trial. Paediatr Anaesth. 2020;30(2):168–80.	Intervention and outcomes only for children
57. Zhang QL, Xu N, Huang ST, Cao H, Chen Q. WeChat-assisted pre-operative health education improves the quality of life of parents of children with ventricular septal defects: A prospective randomised controlled study. J Paediatr Child Health. 2021;57(5):664–9.	Intervention and outcomes only for parents

Effectiveness of family-centred educational interventions for anxiety, pain and behaviours of children and adolescents and anxiety of their parents during the perioperative journey: A systematic review and meta-analysis

Supplement 3: Characteristics of included studies

Author (year) Location Setting	Study design	Participants age range in years (Mean)	Intervention Sample size (n) (time of intervention)	Comparator/ control Sample size (n)	Summary of intervention effect based on authors' results (measure used)			
					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Aydin & Uyar (2021)[61] Turkey Hospital	RCT	children 6–8 (6) mothers	Informative story book *Elif is being operated on* which gives details about pre-operative preparation such as admission to hospital, fasting before surgery, putting on surgical suits before surgery and going to the operating theatre. Books were either read by literate children or the mother of illiterate children. (ni=60; nf=51) Child F:M (n) (25:26) Time: Read at least once before the surgery (not specified when).	Standard pre-operative care and a non-medical colourful story book appropriate for their age. (ni=60; nf=51) Child F:M ratio (n) (24:27)	Not assessed	Anxiety scores lower in EG than in CG at T0 (holding area) and T1 (while entering the operating room) (T0 – EG M=36.14; SD=11.7 vs CG M=40.38; SD=11.2; p=0.03 and T1 EG M=27.16; SD=5.5 vs CG M=29.67; SD=5.8; p=0.022, respectively). Also, those who read the intervention book more than three times had lower anxiety scores than those who read two times or less (p<0.001). (m-YPAS, observed)	Not assessed	No significant differences between groups in terms of mothers' anxiety on the day of surgery (EG M=41.06; SD=8.1 vs CG: M=38.41; SD=9.3; p=0.11). (STAI, self-reported)
Bartik & Toruner (2018)[60] Turkey Hospital (interview room)	Quasi-experimental	children 7–12 (7–8) caregivers	Pre-operative program which included: • a booklet *The Care of Your Child in Outpatient Surgery* (how children feel about the procedure, how to prepare a child for surgery, what to bring to hospital, admission process, monitoring a child after surgery, post-operative nutrition and mobilisation, home care), verbal information and telephone counselling for parents • *The Colouring Book* (colouring pictures, puzzles and games with information for children about pre- and post-operative procedures) • information about the surgical process for children – gown, hat and purpose of wristbands – using a medical play doll. (ni=36; nf=36) Child F:M ratio (n) (4:32) Time: Day before surgery	Standard pre-operative care (ni=37; nf=37) Child F:M ratio (n) (4:33)	Not assessed	Not assessed	Not assessed	Reduced pre-operative anxiety in EG, with significant difference between groups (EG M=48.08; SD=9.52 vs CG M=53.59; SD=3.94, p=0.01). Reduced post-operative anxiety, with significant difference between groups (EG M=38.27; SD=8.93 vs CG M=53.81; SD=6.92, p=0.001). (STAI, self-reported)

Author (year) Location Setting	Study design	Participants age range in years (Mean)	Intervention Sample size (n) (time of intervention)	Comparator/ control Sample size (n)	Summary of intervention effect based on authors' results (measure used)			
					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Batuman et al. (2015)[52] Turkey Hospital	RCT	children 5–12 (7–8) parents	Information video regarding the perioperative period (fasting requirement, anaesthetic techniques and equipment used). Two scenes were created with a child, nurses, doctors and parents. (ni=21; nf=21) Time: On the day of surgery.	Standard pre-operative care (verbal information) (ni=21; nf=21)	Not assessed	Operating room at induction of anaesthesia: Anxiety scores were lower in EG than in CG (EG M=27.8; SD=7.8 vs CG M=78.9; SD=12.9; p=0.001). (m-YPAS, observed)	One week post-operatively: • difficulty getting to sleep (EG n=0 vs CG n=11) • nocturnal enuresis (EG n=0 vs CG n=5) • fear of dark (EG n=0 vs CG n=4) • objection to going to bed at night (EG n=0 vs CG = 10) • decreased appetite (EG n=0 vs CG n=12), p<0.05. Children with high anxiety levels at induction had higher ratios of difficulty getting to sleep, objection to going to bed at night, crying or being upset when left alone for a few minutes, temper tantrums, fear of dark, decreased appetite, refusal to comply with parents (r=0.65 p=0.001; r=0.56, p=0.001; r=0.37, p=0.02; p=0.02, r=0.35; p=0.04, r=0.31; p=0.001, r=0.52; p=0.03, r=0.34; respectively). (PHBQ, reported by parents)	Not assessed
Chartrand et al. (2017)[54] Canada Hospital	RCT	children 3–10 (5.3) parents	DVD *You and your child in the RR* designed to provide parents with knowledge about the equipment and procedures in the RR, roles of health care professionals and potential reaction of children waking up after general anaesthesia. (ni=59; nf=49) Child F:M ratio (n) (22:27) Parent F:M ratio (n) (38:11) Time: not detailed.	Standard pre-operative care (ni=64; nf=56) Child F:M ratio (n) (19:37) Parent F:M ratio (n) (47:9)	No significant difference between groups at the RR (EG M=1.51; SD=1.89 vs CG M=2.06; SD=2.36; p=0.27). Significantly reduced pain in EG in the day care surgery unit (EG M=0.49; SD=0.84 vs CG M=1.16; SD=1.59; p=0.02). (mCHEOPS, observed by assessor)	Not assessed	Post-operative distress is defined as facial, verbal and affective manifestations and motor indicators of emotional distress related to anxiety, anger, fear and pain. No significant difference between groups regarding children's distress (EG M=26.73; SD=19.19 vs CG M=23.34; SD=17.51; p=0.59). (EDCEO, which includes six items)	T1 (immediately before entering the RR), T2 (5 minutes after entering the RR), T3 (5 minutes after leaving the RR with their child). No significant difference between groups in parents' anxiety at T1, T2 or T3. At T1: EG M=3.32; SD=2.50 vs CG M=3.51; SD=2.43; t=0.68, p=0.66. At T2: EG M=2.76; SD=2.60 vs CG M=2.73; SD=2.44, t=0.68, p=0.66. At T3: EG M=0.68; SD=1.71 vs CG M=1.31; SD=2.01, t=0.68, p=0.66. (VAS, self-reported)
Coskunturk & Gozen (2017)[59] Turkey Hospital	RCT	children 6–12 (8–9) mothers	Pre-operative program 'ITPEP' that included: • educational booklet • therapeutic play • a short visit to PACU. (ni=23; nf=23) Child F:M ratio (n) (13:10) Time: Day before surgery.	Standard pre-operative care (conventional mode of education) (ni=20; nf=20) Child F:M ratio (n) (11:9)	Not assessed	No significant difference between groups on the day before surgery (EG M=40.90; SD=7.20 vs CG M=39.40; SD=6.72; p=0.48). Significantly reduced levels in the experimental group six hours post-operatively (EG M=27.40; SD=5.03 vs CG M=43.80; SD=4.55, p=0.01). (STAI-C, self-reported)	Not assessed	No significant difference in pre-operative parental anxiety (day before surgery) between groups (EG M=34.20; SD=11.10 vs CG M=31.70; SD=9.70; p=0.43). Significant difference in post-operative parental anxiety (six hours post-operatively) between groups (EG M=16.30; SD=7.30 vs CG M=39.00; SD=8.90; p=0.01). (BAI, self-reported)
Cumino et al. (2013)[78] Brasil Hospital	RCT	children 4–8 (5–6) parents	Leaflet for parents containing information about the anaesthetic procedure (ni=36; ni=36) Child F:M ratio (n) (17:19) Time: After pre-anaesthetic assessment	Standard pre-operative care (verbal information) (ni=36; nf=36) Child F:M ratio (n) (10:26)	Not assessed	No significant difference between groups in the surgical centre waiting room (WR) and operating room (OR) before induction of anaesthesia (WR: EG Mdn=25.00[23.40-30.00] vs CG Mdn=26.70 [24.30-38.40] p=0.45; OR: EG Mdn=40.80[33.40-57.60] vs CG Mdn=44.2[25.9-56.7] p=0.68). (m-YPAS, observed)	Not assessed	No significant difference between groups pre-operatively (EG Mdn=9.00 [3.25-17.50] vs CG Mdn=8.00 [5.25-16.00], p=0.84). (HAM-A, self-reported)

Author (year) Location Setting	Study design	Participants age range in years (Mean)	Intervention Sample size (n) (time of intervention)	Comparator/ control Sample size (n)	Summary of intervention effect based on authors' results (measure used)			
					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Cumino et al. (2017)[79] Brasil Hospital	RCT	children 4–8 (5–6) parents	Informed group that received a leaflet containing information about the anaesthetic procedure. (ni=21; nf=21) Child F:M ratio (n) (7:14) Parent F:M ratio (n) (20:1) Time: Day before surgery.	Standard pre-operative care (only information). (ni=21; nf=21) Child F:M ratio (n) (7:14) Parent F:M ratio (n) (20:1)	Not assessed	No statistically significant differences between EG when compared to CG in the holding area (EG Mdn=23.40 [23.40-25.00], vs CG Mdn=23.40 [23.40-41.70], p=0.19). Statistically significant differences between EG and CG at induction of anaesthesia (EG Mdn=28.40[23.40-45.00] vs CG Mdn=55.00 [30.00-68.40], p=0.02). (m-YPAS, observed)	Not assessed	Not assessed
Eijlers et al. (2019)[80] Netherlands Hospital	RCT	children 4–12 (9) parents	Virtual reality video environment modelled according to the real operating theatre and medical staff (two versions, one for children aged 4–7 and 8–12). (ni=100; nf=94) Child F:M ratio (n) (49:45) Time: Day of surgery.	Standard pre-operative care (ni=100; nf=97) Child F:M ratio (n) (41:56)	No differences in pain levels were found between EG and CG, whether self-reported with FPS-r in RR (EG 2.00 [0.00-4.00] vs CG 2.00 [0.00-2.50], p=0.70), nurse-observed with FLACC in RR (EG 0.00 vs CG 0.00, p=0.70) or parent-observed with PPPM at home (EG 3.00 [0.00-5.00] vs CG 3.00 [1.00-8.00], p=0.41). (FPS-r self-reported) (FLACC observed) (PPPM – parent observed)	No differences in anxiety levels were found between groups at different time points: T1 (hospital admission), T2 (holding area), T3 (induction of anaesthesia), T4 (RR), T5 (at home). mYPAS: • T2 EG Mdn=28.30 [23.30-36.70] vs CG Mdn=28.30 [23.30-41.70], p=0.77 • T3 EG Mdn=40.00 [28.30-58.30] vs CG Mdn=38.30 [28.30-53.30], p=0.86. VAS: • T2 EG Mdn=3.00 [0.10-5.50] vs CG Mdn=3.50[0.00-6.00], p=0.75. (m-YPAS, observed) (VAS, self-reported)	No differences were found in emergence delirium symptoms between groups at T4 (EG Mdn=7.00[5.00-8.00] vs CG Mdn=6.00[5.00-9.00], p=0.266). (PAED, observed)	No differences in pre-operative parental anxiety were found between groups, either when self-reported (STAI-state) (EG Mdn=41.00 [34.50-48.50] vs CG Mdn=40.5 [33.00-50.00], p=0.75), or when observed (VAS) (EG Mdn=3.00 [2.00-5.00] vs CG Mdn=3.50 [2.00-5.00], p=0.42). (STAI self-reported) (VAS observed)
Faramarzi et al. (2020)[85] Iran Hospital	RCT	children 9–12 (10) parents	Usual care and an informative booklet plus multi-component preparation program including: • a DVD with adequate information through an educational tour of the pre-operative office, arrival at the surgical ward, equipment used in the operating room and post-operative recommendations • therapeutic play (demonstration of obtaining vital signs and equipment used). (ni=141; nf=121) Child F:M ratio (n) (68:53) Time: From two weeks until a few minutes before surgery.	Usual care and an informative booklet about the anatomy of tonsils, indications and complications of tonsillectomy, recommendations for the post-operative period. (ni=141; nf=120) Child F:M ratio (n) (59:61)	Pain scores in PACU and at four and eight hours post-operatively (4h and 8h) were not statistically significant between groups. • PACU EG M=1.35; SD=0.52 vs. CG M=1.21; SD=0.81; p=0.11 • 4h EG M=1.61; SD=0.47 vs. CG M=1.73; SD=0.84; p=0.17 • 8h EG M=2.29; SD=0.56 vs. CG M=2.33; SD=0.92; p=0.68. (VAS, observed)	Not assessed	Not assessed	Not assessed
Fernandes et al. (2014)[74] Portugal Hospital	RCT	children 8–12 (10) parents	Children received educational materials in the format of a board game, video or a booklet with information about surgery or hospitalisation (health care professionals, medical instruments, clinical procedures and induction of anaesthesia, changing of clothes, parental separation for surgery). (ni=45; nf=45) Child F:M ratio (n) (12:33) Parent F:M ratio (n) (40:5) Time: Day of surgery.	No material received, but the same information was given. (ni=35; nf=35) Child F:M ratio (n) (6:29) Parent F:M ratio (n) (30:5)	Not assessed	Not assessed	Not assessed	No statistically significant differences in parental anxiety between EG and CG (p=0.78, d=0.06). (STAI form Y, self-reported)

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					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Fernandes et al. (2015)[75] Portugal Hospital	RCT	children 8–12 (9) parents Child F:M ratio (n) 21:69 Parent F:M ratio (n) 78:12	Multimedia application/game 'An Adventure at the Hospital' divided into different levels to illustrate hospital procedures and perioperative stages (from admission to aftercare). (ni=30; nf=30) Time: Day of surgery	Standard pre-operative care / no intervention (ni=30; nf=30)	Not assessed	Not assessed	Not assessed	Pre-operative parental anxiety was lower in EG (EG M=1.89; SD=0.54) than CG (CG M=2.19; SD=0.60; p=0.033). (STAI form Y (0-4), self-reported)
Fincher et al. (2012)[69] Australia Hospital	RCT	children 3–12 (6) parents	Pre-operative preparation program including: • a photo file with the sequence of events that occur when a child is going to theatre • demonstration of equipment using peer modelling approach • a tour of pre-operative bay and PACU. This program was tailored according to the child's age. Older children received more specific explanations. (ni=37; nf=35) Child F:M ratio (n) (16:19) Time: One or two days before surgery for children aged 3–5 and five to ten days for children aged 6 and older.	Standard pre-operative care (ni=36; nf=32) Child F:M ratio (n) (18:14)	PACU, arrival at ward from PACU, 24 hours and two weeks post-operatively. (Time for the results not detailed.) The pain score in EG was significantly lower than in CG. EG Mdn=2.00 [IQR 5.00] vs CG Mdn=4.00 [IQR 4.00], p=0.001). (FLACC if children aged <5; FPS-r if 5, observed)	Baseline, admission to ward, holding area, anaesthetic room, induction, PACU, arrival at ward from PACU, 24 hours and two weeks post-operatively. No significant difference between groups in pre-operative anxiety (-0.59; 95% CI [-1.23 to 0.06], p=0.07). Decreasing anxiety post-operatively regardless of group allocation. (m-YPAS, observed)	Two weeks post-operatively. Majority of children (47.9%) experienced negative behavioural changes two weeks post-operatively with a total score > 81. No significant difference in post-operative behaviour between groups (EG M=83.66; SD=5.41 vs CG M=83.40; SD=11.86; p>0.05). (PHBQ, assessed by the parents)	Baseline, admission to ward, holding area. Significant difference in anxiety between groups (-2.32 CI [-4.06 to -0.56], p=0.01). (STAI, self-reported)
Kassai et al. (2016)[72] France Hospital	RCT	children 6–17 (12) parents	Comic information leaflet, with information regarding the surgical process and illustrations, in addition to verbal information. (ni=57; nf=54) Child F:M ratio (n) (29:25) Time: Few days before hospitalisation	Standard pre-operative care (verbal information) (ni=58; nf=57) Child F:M ratio (n) (30:27)	Not assessed	Anxiety scores lower in EG than in CG (EG 32.09 (baseline) to 30.07 (pre-op); CG 30.40 (baseline) to 31.30 (pre-op); estimate=-2.90, SE=0.90, t=-3.21, p=0.002) (STAIC-S, self-reported)	Not assessed	No significant differences between groups pre-operatively (estimate=-0.03, SE=0.06, t=0.48, p=0.63). (STAI for children, self-reported)
Kumar et al. (2019)[64] India Hospital	RCT	children 5–15 (8–9) parents	Preparation program, in which children and parents were shown images of the operating room, ICU and post-operative ward. A pamphlet was also given. Children were also allowed to play games and videos during their stay in the pre-operative ward. (ni=30; nf=28) Child F:M ratio (n) (7:21) Time: Day before surgery.	Standard pre-operative care (ni=30; nf=27) Child F:M ratio (n) (15:12)	Post-operative pain score significantly low (p<0.001) in EG (2.00[1.00-5.00]), compared to CG (4.00[2.00-7.00]). (The Wong-Baker scale, self-reported)	No significant differences between groups for pre-operative anxiety scores. (State pre-operative scores: EG M=45.70; SD=5.10 vs CG M=44.20; SD=5.30; p=0.29.) Post-operative anxiety scores significantly lower in EG than in CG (State post-operative scores: EG M=27.40; SD=2.90 vs CG M=39.70; SD=4.30; p<0.001). (STAI-C, self-reported)	Not assessed	No significant difference between groups in pre-operative state anxiety (EG M=63.00; SD=11.70 vs CG M=64.10; SD=7.50; p=0.69) and trait anxiety (EG M=53.50; SD=14.90 vs CG M=51.60; SD=9.20; p=0.58). Significantly lower post-operative state anxiety in EG than CG (EG M=42.00; SD=4.40 vs CG M=54.50; SD=7.80 p<0.001). There was no difference in post-operative trait anxiety between groups. (STAI, self-reported)

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					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Li et al. (2007)[71] Hong Kong Hospital	RCT	children 7–12 (9) parents	Therapeutic play intervention for five children (and one of their parents) per group. (ni=126; nf=97) Child F:M ratio (n) (30:67) Time: One week before surgery.	Standard pre-operative care. (ni=122; nf=106) Child F:M ratio (n) (33:73)	No significant difference in mean post-operative pain scores for children in EG and CG (EG M=4.19; SD=1.18 vs CG M=4.47; SD=1.24; t [201] =1.68, p=0.09). (VAS, self-reported)	Assessed at three points: pre-intervention, post-intervention and post-surgery. Statistically significant main effect, suggesting that children in EG experienced lower anxiety scores than children in CG (F (1,201) =5.36, p<0.02, Partial η2=0.04). Children in EG reported lower anxiety scores than children in CG in both post-intervention and post-operation (post-intervention scores EG M=34.36; SD=8.09 vs CG M=38.60; SD=8.53; post-operation scores EG M=33.58; SD=5.90 vs CG M=36.16; SD=5.60). (Chinese version of CSAS-C, observed)	Statistically significant difference in mean CEMS for children in experimental and control groups (EG M=10.46; SD=3.79 vs CG M=13.63; SD=4.49; t [201] =5.40, p<0.001), with children receiving the intervention exhibiting fewer emotions at induction of anaesthesia. (CEMS, observed)	Not assessed
Liguori et al. (2016)[69] Italy Hospital	RCT	children 6–11 (8–9) parents/ guardians	Six-minute video, in which two clown physicians take a tour of one of the operating theatres ('Clickamico' or 'Buddyclick'). Video integrated into an app for mobile devices. (ni=20; nf=20) Child F:M ratio (n) (11:9) Time: Afternoon before the surgical procedure.	Standard pre-operative care (ni=20; nf=20) Child F:M ratio (n) (9:11)	Not assessed	Significantly lower pre-operative anxiety in EG (EG M=33.00; SD=18.40 vs CG M=48.60; SD=15.90; p=0.01. (m-YPAS, observed)	Not assessed	Not assessed
Lin et al. (2019)[70] Taiwan Hospital	RCT	children 3–12 (6) parents/ caregivers	Multi-component family-centred pre-operative preparation program including: • a tour of the pre-operative area and recovery room • four-minute cartoon video 'I am not afraid of surgery' • familiarisation with medical equipment. (ni=35; nf=32) Child F:M ratio (n) (9:23) Time: Days before surgery (not specified).	Standard pre-operative care (ni=35; nf=34) Child F:M ratio (n) (7:27)	Not assessed	Not assessed	T1 (baseline), T2 (holding area), T3 (induction of anaesthesia), T4 (RR). Pre-operative scores in EG were 3.4 points lower than those in CG at T3 vs T1 (estimated effect =-3.42, SE=1.23, p=0.01) and T2 vs T1 (estimate=-2.37, SE=1.25, p=0.06) (Linear Mixed-Effects Model). Behaviour score of the control group increased over time from T1 to T3 (7.87 ⇑12.23). (CEMS, observed) None of the children in EG had scores of 4 or 5 upon arrival in the RR, but two children in CG had scores of 4. Children's post-operative behaviour did not significantly differ between the two groups upon arrival or at 15 minutes (p=0.59, p=0.80, p=0.30, p=0.48, respectively; Fisher's exact test). (Post-op scoring system for emergence delirium, by Cole et al. (2002), observed). Two weeks after surgery, one child from EG experienced negative behaviours (waking up crying) whereas none of the children in CG exhibited negative behaviours. (Telephone follow-up, reported by parents).	The anxiety of the caregiver decreased over time, but there were no differences between groups and no interactions with time (T1–T3 EG 24.39–21.48 vs CG 24.98–22.13). (APAIS, self-reported)

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					Pain	Anxiety	Behaviour	Anxiety
Matthyssens et al. (2020)[73] Belgium Hospital	RCT	children 5–11 (7) parents	CliniPup® (game that addresses pain management and what happens throughout the surgical process) and links to the e-learning module for parents and digital scoring tools. (ni=43; nf=25) Child F:M ratio (n) (8:17) Time: Seven days before surgery.	Standard pre-operative care. (ni=29; nf=25) Child F:M ratio (n) (9:16)	Pain score in EG was significantly lower than in CG at T1 (b=1.12, 95% CI from 2.10 to 0.14; p=0.03). No statistically significant difference between groups at T3 and T4 (p values not detailed). (VASp) (self-reported + assessed by parents)	T0 (one week pre-operatively), T1 (baseline, at home, after playing CliniPup®/ empty game), T2 (at hospital admission), T3 (hospital, post-operatively, before discharge), T4 (at home, one week post-operatively), T5 (one month post-operatively). Anxiety levels at T1 significantly lower in EG than CG (EG M=1.90 vs CG M=4.50, p=0.003). Anxiety Levels at T2 with no significant differences between groups (EG M=2.40 vs CG M=4.10, p=0.14). Anxiety and pain were significantly correlated in this study at T1, T2 and T4 (rsT1=0.26, p=0.04; rsT2=0.34, p=0.04; rsT4=0.51, p=0.00, respectively). (VASa) (0-4), self-reported and assessed by parents)	Measured at T5. No significant differences between groups (p=0.78) one month after surgery. (PHBQ-AS, reported by parents)	Measured at T2. No significant differences between groups pre-operatively (p=0.45, n=34). (STAI, self-reported)
Park et al. (2019)[58] South Korea Hospital	RCT	children 4–10 (6–7) parents	Virtual reality tour video in which a little penguin introduces itself and explains details of the pre-operative preparation process to children. Parents watched the same video via mirroring display. (ni=40; nf=40) Child F:M ratio (n) (13:27) Time: One hour before surgery.	Children watched VR-guided tour of the operating theatre. (ni=40; nf=40) Child F:M ratio (n) (20:20)	Not assessed	Significant difference between groups pre-operatively (EG Mdn=28.30 [23.30-36.70] vs CG Mdn=38.30[23.30-44.20]; p=0.03). (m-YPAS Korean version, observed)	No statistical differences between groups for compliance at induction (EG n=30 of 40 vs CG n=26 of 40 perfect compliance; p=0.72). (ICC, observed)	Parents in EG showed less anxiety (after induction) than those in CG (EG Mdn=30.00[10.00-62.50] vs CG Mdn=55.00 [40.00-80.00], p=0.03). (101 Numeric Rating Scale, self-reported)
Ryu et al. (2017)[55] Korea Hospital	RCT	children 4–10 (6) parents	Four-minute virtual reality video showing the operating theatre and explaining the perioperative process. (ni=35; nf=34) Child F:M ration(n) (17:17) Time: One hour before surgery.	Standard pre-operative care. (ni=35; nf=35) Child F:M ratio (n) (11:24)	Not assessed	Anxiety scores lower in EG than in CG in the pre-operative holding area before entering the theatre (EG Mdn=31.70[23.30-37.90] vs CG Mdn=51.70 [28.30-63.30], p<0.001). (m-YPAS, observed)	Significant differences in compliance and distress between experimental and control groups. More children in EG showed perfect compliance (ICC score 0) (EG 28 of 34 vs CG 12 of 35, p<0.001). (ICC, observed) The score PBRS was significantly lower in the experimental group than in the control group (EG Mdn=0.00[0.00-1.00] vs. CG Mdn=1.00[0.00-4.00], p=0.01). (PBRS, observed	Not assessed
Ryu et al. (2018)[56] Korea Hospital	RCT	children 4–10 (5–6) parents	Five-minute virtual reality game where the player would be given the opportunity to interact and explore the operating theatre environment. (ni=35; nf=34) Child F:M ratio (n) (16:18) Time: One hour before surgery.	Standard pre-operative care (conventional mode of education) (ni=35; nf=35) Child F:M ratio (n) (13:22)	Not assessed	Pre-anaesthesia anxiety levels lower in EG than CG (EG Mdn=28.30 [23.30-36.70] vs CG Mdn=46.70 [31.70-51.70], p<0.001). (m-YPAS, observed)	No significant differences between groups (EG Mdn=0.00[0.00-1.00] vs CG Mdn=1.00[0.00-2.00], p=0.09). (PBRS) Better compliance in EG than in CG (p=0.038). (ICC, observed)	Not assessed

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					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Ryu et al. (2019)[57] Korea Hospital	RCT	children 4–10 (6) parents	Four-minute virtual reality video showing the operating theatre and explaining the perioperative process. (ni=43; nf=41) Child F:M ratio (n) (12:29) Time: One hour before surgery.	Standard pre-operative care (without intervention) (ni=43; nf=39 Child F:M ratio (n) (18:21)	Not assessed	Pre-operative anxiety levels lower in EG than CG at the induction of anaesthesia (EG Mdn=38.30 [23.30-50.90] vs CG Mdn=46.70 [33.30-63.30], p=0.02). (m-YPAS, observed by blinded assessor)	The incidence of emergence delirium was similar in the two groups (EG n=14 of 41 vs. CG n=16 of 39, p=0.77). PAED score between groups was similar without statistical significance (EG=8.00 [3.50-12.50] vs CG=8.00 [5.00-12.00], p=0.79). (PAED) Post-operative day 1: three children in EG reported behavioural disturbance vs two in CG. Post-operative day 14: one child in EG reported behavioural disturbance vs none in CG. No significant difference between the two groups on post-operative day 1 (p=0.671) and day 14 (p=0.329). (PHBQ for ambulatory surgery, recorded by calling the parents on day 1 and 14 after surgery)	Not assessed
Sabaq & El-Awady (2012)[77] Egypt Hospital	Quasi-experi-mental	children 9–12 (10) mothers	Pre-operative program including: a pre-operative tour therapeutic play (a manikin demonstration and a return demonstration by the children) of pre-operative procedures. (ni=60; nf=60) Child F:M ratio (n) (34:26) Time: Day before surgery.	Standard pre-operative care (ni=60; nf=60) Child F:M ratio (n) (35:25)	Not assessed	Lower anxiety scores post-intervention in EG than in CG. STAI Mean scores: • EG M=36.63, SD=2.18 • CG M=44.80, SD=3.18 (p<0.001). Low anxiety levels (37): • EG n=45 of 60 • CG n=35 of 60. Moderate (38-44): • EG n=8 of 60 • CG n=15 of 60. High anxiety (37): • EG n=7 of 60 • CG n=10 of 60. (STAI, self-reported)	Compliance during induction of anaesthesia higher in EG than in CG (Compliance EG n=39 of 60 vs CG n=20 of 60, p=0.001; non-compliance EG n=21 of 60 vs. CG n=40 of 60, p=0.001). (ICC, observed) Children in EG had improved eating behaviour compared with children in CG (POD2 50.00% vs 33.30%; POD3 66.70% vs 41.70%; POD7 83.30% vs 66.70%, p0.05). Children in CG had more problems falling asleep, staying asleep and waking up crying than children in EG (POD1 51.30% vs. 44.60%, p=0.05; POD2: 40.70% vs. 33.20%). (PHBQ), completed by mothers)	Mothers in EG had lower anxiety scores than those in CG. STAI Mean scores: • EG M=36.80, SD 2.19 • CG M=43.80, SD 3.17 (p0.01). (STAI, self-reported)
Tabrizi et al. (2015)[65] Iran Hospital	RCT	children 8–10 (9–10) parents	Pre-operative visits to children and parents were performed with a booklet and explanation provided by the anaesthesiologist. (ni=18; nf=18) Child F:M ratio (n) (8:10) Time: Day before surgery.	Standard pre-operative care (ni=15; nf=15) Child F:M ratio (n) (9:6)	Not assessed	Children who received training by the anaesthesiology residents (EG) had less anxiety on the morning of surgery than the ones in CG (EG M=30.8; SD=6.0 vs CG M=34.1; SD=6.7). However, the difference was not statistically significant (p=0.1). (STAIC, self-reported)	Not assessed	Anxiety reduced after reading the book. EG before reading the book M=41; SD=12.7 vs after reading the book M=35.6; SD=9.5; p=0.04. There was no significant difference in the mothers' anxiety levels between groups just before the operation (EG M=35.6; SD=9.5 vs CG M=42.8; SD=14; p=0.1). (STAI, self-reported)
Vaezzadeh et al. (2011)[67] Iran Hospital	RCT	children 7–1 (9) mothers	Therapeutic play that included a group of structured activities, such as a pre-operative tour and a manikin demonstration, with a return demonstration by the children, of pre-operative procedures. (ni=61; ni=61) Child F:M ratio (n) (19:42) Time: Day before surgery.	Standard pre-operative care (ni=61; nf=61) Child F:M ratio (n) (18:43)	Not assessed	Children in EG reported significantly lower pre-operative anxiety scores in (EG M=31.44, SD=5.87 vs CG M=38.31, SD=7.44 post-intervention, respectively) (p=0.001) (SSAS-c), self-reported	Not assessed	Not assessed

Author (year) Location Setting	Study design	Participants age range in years (Mean)	Intervention Sample size (n) (time of intervention)	Comparator/ control Sample size (n)	Summary of intervention effect based on authors' results (measure used)			
					Child and adolescent outcomes			Parental outcomes
					Pain	Anxiety	Behaviour	Anxiety
Wakimizu et al. (2009)[76] Japan Hospital	RCT	children 3–6 (4–5) parents/ caregivers ni=158 nf=150 n (one month after surgery) = 144	Visualisation of the educational video 'Shujutsu ni ikou', that introduces the experience of a five-year-old boy who is hospitalised for inguinal hernia. The participants in this group could watch the video as many times they wished during the week before surgery. Auxiliary booklet for the video was given to caregivers. (ni=77; nf=74) Child F:M ration (n) (28:49) Parent F:M ratio (n) (74:3) Time: The week before surgery.	Visualisation of the educational video 'Shujutsu ni ikou' once, one week before surgery. Auxiliary booklet for the video was given to caregivers. (ni=81; nf=76) Child F:M ration (n) (31:50) Parent F:M ration (n) (75:6)	Not assessed	Significant group differences and group-by-time interaction in the anxiety levels (F=3.78, p<0.05; F=2.81, p=0.04, respectively) (Wong-Baker FACES Rating Scale, self-reported)	Not assessed	Significant difference between groups over the study period (F=5.49, p=0.02). (STAI-S Japanese version, self-reported)
Yadav et al. (2020)[63] India Hospital	RCT	children 6–12 (8)	15-minute video 'PES' (Pre-operative Educational Schedule) of a visit to the operating theatre explaining pre- and post-operative care and discussing common medication, types of anaesthesia and commonly used medical instruments that the child would see in a surgery. (ni=28; nf=28) Child F:M ratio (n) (7:21) Parent F:M ratio (n) (15:13) Time: Evening before surgery.	Standard pre-operative care (ni=28; nf=28) Child F:M ratio (n) (10:18) Parent F:M ratio (n) (10:18)	Not assessed	Post-intervention, pre-operative anxiety levels (day of surgery, in the morning) were significantly lower in EG than CG (EG Mdn=0.00[0.00-1.00] vs CG Mdn=4.00[2.00-6.70], p=0.00). Mean values: EG M=0.54; SD=1.07 vs CG: M=4.14; SD=2.39. (HAM-A, self-reported)	Not assessed	Significant reduction in anxiety levels in EG post-intervention (EG Mdn=8.50[2.00-19.00] vs CG Mdn=32.50[27.25-35.75]; p=0.00). (HAM-A, self-reported)
Zhu et al. (2018)[40] Singapore Hospital	RCT	children 6–14 (9) parents	Post-operative pain management educational intervention program for parents including: • a booklet • a video • a one-hour face-to-face teaching session on pain management. (ni=54; nf=49) Child F:M ratio (n) (14:35) Parent F:M ratio (n) (42:7) Time: 3–7 days before surgery.	Standard pre-operative care. (ni=54; nf=51) Child F:M ratio (n) (21:30) Parent F:M ratio (n) (44:7)	No statistically significant differences in the highest pain scores at 24 hours after the surgery (EG M=6.62; SD=2.65 vs CG M=5.75; SD=2.73; F=1.22, p=0.30, partial η2=0.02) and between 24 hours and two weeks after surgery among the three groups (EG M=4.67; SD=3.30 vs. CG M=4.60; SD=3.27; F=0.06, p=0.95, partial η2=0.001). (Child's Pain Diary Form for parents with Numeric Rating Scale, parental report after being discharged.)	Not assessed	Not assessed	Not assessed

Abbreviations: CG = control group; EG = experimental group; ni = Initial participants number; nf = final/analysed participants number; Child F:M ratio = Ratio of female to male children; Parent F:M ratio = Ratio of female to male parents; M = mean; MD = mean difference; Mdn = median; SD = standard deviation; APAIS = Amsterdam Pre-operative Anxiety and Information Scale; BAI = Beck Anxiety Inventory; CEMS = Children's Emotional Manifestation Scale; CSAS-C = Chinese version of the State Anxiety Scale for Children; EDCEO = Échelle descriptive du comportement de l'enfant opéré; FLACC scale = Face, Legs, Activity, Cry, Consolability; FPS-r = Faces Pain Scale revised; ICC = Induction Compliance Checklist; HAM-A = Hamilton Anxiety Rating Scale; m-YPAS = The modified Yale Pre-operative Anxiety Scale; mCHEOPS = Modified Children's Hospital of Eastern Ontario Pain Score; PAED = Paediatric Anaesthesia Emergence Delirium score; PBRS = Procedural Behavioural Rating Scale; PHBQ = Post-Hospitalisation Behavioural Questionnaire by Vernon et al. (1966); PPPM = Parents' Post-operative Pain Measure; STAI = State–Trait Anxiety Inventory; STAIC-S= State–Trait Anxiety Inventory for children (State form); STAI-S = State–Trait Anxiety Inventory (State form); VAS = Visual Analogue Scale; POD = post-operative day; RR = recovery room; VR = virtual reality.

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Patient, surgical and clinical factors associated with longer stay in the Post Anaesthesia Care Unit

Abstract

Aim: To explore patient, surgical and clinical factors associated with readiness-for-discharge and total length of stay in the Post Anaesthesia Care Unit (PACU).

Background: Longer stay in the PACU decreases the flow of patients and is associated with increased risk of adverse events. The time to readiness-for-discharge reflects clinical parameters associated with patient flow in the PACU independent of system delays.

Methods: This retrospective cohort study included a randomly selected sample of 244 post-surgical patients admitted to a large private, Australian health service.

Results: The median and average times to readiness-for-discharge were 48 minutes and 56 minutes respectively with a range from 9 to 175 minutes. The total length of stay in the PACU had median and average times of 66 minutes and 73 minutes respectively. Five independent factors associated with longer time to readiness-for-discharge identified in multivariable modelling were: age, surgery duration, post-operative nausea and vomiting, administration of opioids and medical consultation. Additional factors that were determined from univariate analyses to be associated with longer time to readiness-for-discharge from the PACU were hypothermia, moderate or severe pain, major surgery and neurological surgery.

Conclusion: This study found that modifiable and non-modifiable factors are associated with time to readiness-for-discharge. The findings provide a focus for the clinical care of patients in the PACU to optimise the time to readiness-for-discharge and increase patient flow. Understanding factors associated with longer stay helps efficient management of staffing levels and patient flow within the PACU, to improve the quality of care provided.

Keywords: efficiency, length of stay, patient flow, post anaesthesia care unit, post anaesthesia nursing

Introduction

In Australia, between 2016 and 2020, there was a progressive increase (1.7 to 2.8%) in the number of patients on the public surgery waiting list for more than 365 days[1] indicating the inability of public hospitals to keep up with demand.[2] This demand has increased due to the SARS COVID-19 pandemic. The number of admissions for surgery decreased by 9.2 per cent in the 2019–2020 period due to deferral of elective surgery lists, reduced hospital bed capacity and limited availability of consumable resources associated with the pandemic response.[3] This has placed even greater pressure on the health care system to implement measures to reduce waiting lists for elective surgery going forward.

Patients are admitted to a Post Anaesthesia Care Unit (PACU) for continuous observation of their physiological condition – predominantly airway, breathing and cardiovascular status.[4–6] During the immediate post-anaesthesia phase, patients are vulnerable and potentially unstable with an increased risk of adverse events,[4,6,7] and remain in the PACU until they are safe to be transferred to a ward or second-stage recovery unit based on specific discharge criteria.[4,6] Readiness-for-discharge is an aspect of discharge planning that manages and assesses the patient's ability for safe discharge from the PACU. The total length of stay is defined as the time from admission to the PACU until transfer to a receiving unit, it incorporates any clinical time along with system factors associated with transfer.

The length of stay in the PACU can vary according to patient characteristics, surgical factors, occurrence of any complicated clinical events in the recovery period and nonclinical factors.[8–11] Prolonged stay in the PACU decreases patient flow in and out of the PACU,[11,12] increases the risk of adverse events following transfer from the PACU[7,13–15] and was associated with longer hospital admission[13] adding to pressure on the health care system.

Efficient management of an operating suite requires smooth and efficient patient flow across surgical services. Any increase in patient flow increases the number of surgeries that can be performed and, in turn, decreases waiting lists.[16] Key issues in operating theatre under-utilisation that could be attributed to PACU length of stay (LOS) include long turnaround times between surgeries and sessions running over time.[16] Capacity to receive patients into the PACU and bed availability impact patient flow within the PACU.[11] In the public sector alone, a ten per cent increase in current productivity would save $A 208 per hour in salary costs for perioperative surgeons, anaesthetists, nurses and technicians.[16]

The reported average LOS in the PACU varies across countries and organisations due to differences in patient cohorts, protocols and clinical processes.[3,8,14,17,18] Overall LOS is influenced by a combination of time to readiness-for-discharge (clinical factors) and non-clinical or systemic factors such as bed management and transport processes.[10,11,19] Mitigation of both clinical and non-clinical delays that can prolong LOS are integral to efficient management of a PACU. Achieving readiness-for-discharge requires the management and assessment of patients to ensure they have met the PACU discharge criteria including physiological stability and control of pain and nausea,[5,6,20] as well as prompt identification and response to complications or instability.[21] An understanding of the factors that impact the time required to achieve readiness-for-discharge can be used to identify potential improvements in clinical care and PACU flow. To our knowledge, the distinction between time to readiness-for-discharge and LOS overall has not been reported in previous studies.

Aims

The aim of this study was to explore the patient, surgical and clinical factors associated with readiness-for-discharge and total length of stay in the PACU.

Methods

Study design

The design was exploratory and descriptive using retrospective audit of clinical documentation. Human Research Ethics Committee approval was obtained from both the study site (EH2017-173) and university (DUHREC 2017-122).

Setting

This study was undertaken in two acute care sites of the largest private, not-for-profit health care organisation in Victoria, Australia. During the 2016 to 2017 financial year, the organisation performed 112 847 surgical procedures across its nine acute sites. The two sites were selected based on the number of cases and variety of surgical specialities which included cardiac, thoracic, neurological, vascular, general, orthopaedics, gynaecological, urological, plastics, otolaryngological and oral and maxillofacial procedures. These sites performed elective and non-trauma emergency procedures and shared the same protocols for the management of patients in PACU. During the data collection period, Site 1 had 28 operating rooms with 40 PACU bays and Site 2 had 10 operating rooms with 15 PACU bays.

Sample

The target population was all adult and paediatric patients admitted to the PACU following surgery with administration of anaesthesia between 1 January 2016 and 31 December 2016. Excluded were patients who had local or sedation anaesthesia. The overall number of procedures performed in 2016 was 38 407. Three months were randomly selected to account for any seasonal factors and to create an overall representation of surgical procedures at the health service. From a total of 9660 post-surgical patients, a sample was selected using a random number generator. Random selection of patients was stratified according to the relative number of procedures at each site (the ratio of cases from Site 1 and Site 2 was 3:1).

Data collection

A digital case report form (CRF) was used to abstract de-identified data from medical records. Data were collected by one investigator, an experienced operating room nurse familiar with PACU clinical processes and documentation.

Measurements

The main outcome variables were:

1. time to readiness-for-discharge from PACU, defined according to the discharge criteria outlined in Table 1 and measured from time of admission to the PACU until documented recording of readiness-for-discharge
2. total LOS in the PACU, defined as the length of time between recorded time of admission to the PACU and time of transfer to a receiving unit.

Both were measured in minutes. The time that readiness-for-discharge was determined was either clearly recorded in the clinical notes or calculated by the data collector using documented clinical observation data. Documentation of clinical data in PACU occurs every 5–15 minutes.

Data extracted from medical records and used to explore associations with readiness-for-discharge and LOS are summarised and defined in Table 2. These data included: study site, patient characteristics (age, sex, American Society of Anaesthesiologist (ASA) physical status classification system score), surgical characteristics (surgical classification, speciality, anaesthesia technique, duration of surgery) and clinical factors (pain, nausea and vomiting, hypothermia), complex recovery indicators (analgesic administration, request for medical consultation) and time points (admission to and discharge from the PACU).

Table 1: Site-specific readiness-for-discharge criteria

Criterion			
Total discharge score must be >5	Pain	Nil/minimal	2
		Moderate	1
		Severe	0
	Bleeding	Nil/minimal	2
		Moderate	1
		Severe	0
	Post-operative nausea and vomiting	Nil/minimal	2
		Controlled IM/IV	1
		Severe	0
		Total:	
Physiological parameters must not meet MET activation criteria			
Discharge protocol following medication administration: • 15 minutes post administration of IV opioid • 30 minutes post administration of IM opioid or IV vasopressor • 60 minutes post administration of Naloxone.			

IM= Intramuscular; IV= Intravenous; MET= Medical Emergency Team

Statistical methods

Statistical analyses were performed using IBM-SPSS version 26 and Stata/SE version 16 software. Exploratory data analysis included descriptive statistics of frequencies, mean, median, interquartile range (IQR) and range to summarise patient, surgical, clinical and system factors related to length of stay in the PACU. Variables were either continuous (e.g. length of stay in the PACU and age) or categorical (e.g. sex and ASA score). Normality testing was performed using the Shapiro–Wilk test. The relationships between variables were explored using Pearson's chi-squared tests and, for non-normal continuous variables, using non-parametric tests such as a Mann–Whitney U test or the Kruskal–Wallis test. Correlations of skewed continuous variables were described using Spearman's rho (r_s) analysis.

Negative binomial regression modelling

The outcome variable for regression modelling purposes was the length of time to readiness-for-discharge from the PACU. This variable was measured in minutes and was rounded to the nearest whole number. Due to the right skewed nature of the count data (see Figure 1) and because the conditional variance potentially exceeded the conditional mean, we chose negative binomial regression.

The association of all selected independent variables with the outcome 'readiness-for-discharge from PACU', was examined using backward elimination, multivariable, negative binomial regression modelling. In the first step all independent variables were considered in a multivariable model if found to be significant at a level

Table 2: Definitions for patient, surgical and clinical characteristics in the case report form

Characteristics		Definitions
Patient characteristics	ASA score	American Society of Anaesthesiologists (ASA) physical status classification system score is a pre-anaesthesia co-morbidity assessment. ASA scores range from ASA-1 (normal healthy patient) to ASA-6 (declared brain-dead patient for organ donation). No patients had a score more than ASA-4 (severe systemic disease that is constant threat to life). For the purpose of the analyses, ASA scores were further categorised to healthy/mild systemic disease (ASA-1 and ASA-2) or severe systemic disease (ASA-3 and ASA-4). A patient's ASA is assessed by their anaesthetists prior to surgery.
Surgical characteristics	specialty	Surgical specialties were categorised as ear, nose and throat (ENT), oral and maxillofacial (OMF), plastics, urology, gynaecology, orthopaedic, vascular, general, neurological.
	classification	Surgery was classified as major surgery if general or regional anaesthesia and/or ventilatory support was required, great cavities of the body or orthopaedic intervention involving joints was involved, there was risk of severe bleeding or it was life threatening. Surgery was classified as minor surgery if skin, mucous membrane or superficial tissue was manipulated.
	anaesthetic technique	Anaesthetic technique was categorised as local anaesthetic with sedation, general anaesthetic (GA), spinal anaesthetic, GA with regional block.
	duration of surgery	Duration was measured in minutes as recorded in the surgical nursing notes.
Clinical characteristics	pain	Pain intensity was measured on an 11-point numerical rating scale where 0 represents 'no pain' and 10 'worst pain possible'. For the purpose of the analyses, presence of pain was further categorised as nil/mild (0–3) and moderate/severe (4–10).
	nausea and vomiting	Any post-operative nausea or vomiting (PONV) requiring administration of an anti-emetic medication in PACU.
	hypothermia	Temperature <36^{0}C on arrival to the PACU.
	analgesia	Administration of any analgesia in PACU. This was further categorised to use of opioids in PACU (yes/no).
	medical consultation	Any physiological aberration that required a review by a surgeon or anaesthetist while in PACU.

of $p<0.2$ in univariable, negative binomial regression models. The next step involved removing variables that were determined to be non-significant ($p>0.05$), one at a time, from the multivariable model based on a likelihood ratio test that compared models with and without the independent variable. For the independent variables that remained in the final multivariable, negative binomial regression model, associations were considered statistically significant at a level of significance of 5 per cent. Robust standard errors were used to calculate 95 per cent confidence intervals in the final multivariable model. Five cases were removed from the multivariable modelling because of missing data.

Results

The average time to readiness-for-discharge from the PACU was 56.0 minutes with a range of 9 minutes to 175 minutes. The average total LOS in the PACU for all patients was 73.3 minutes with a minimum of 15 minutes and maximum of 215 minutes. The difference in time between readiness for discharge

and LOS was determined to be a system delay; for most patients (62%, n=151/244) this system delay was more than five minutes. The average system delay was 17.3 minutes, ranging from zero to 130 minutes. The median (IQR) for time to readiness-for-discharge was 48 (IQR 33–70) minutes and for LOS was 66.5 (IQR 46–89) minutes. The median system delay was ten minutes (IQR 5–24, indicating that half of the patients were transferred from PACU within ten minutes of being assessed as ready-for-discharge. Higher frequencies of patients were assessed as ready-for-discharge at 30, 35, 45 and 60 minutes compared to other times (Figure 1). These times corresponded with assessment by the PACU nurse. A dedicated transport nurse assisted with the transfer of patients from the PACU for 59 per cent (n=144/244) of patients. The median system delay for patients with a transport nurse was ten minutes (IQR 5–20), which was significantly less than for those without a transport nurse (median 15, IQR 5–30 minutes; Mann–Whitney U=4985.5, p<0.001).

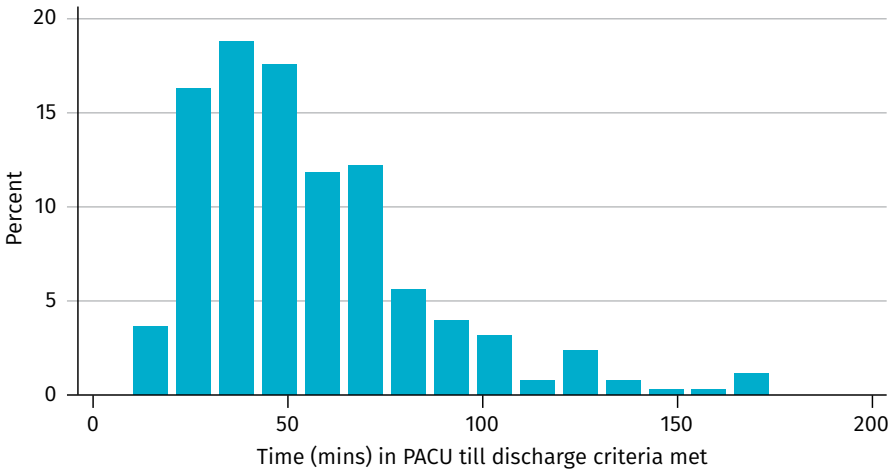

Figure 1: Distribution of time to readiness-for-discharge from the PACU (minutes)

Time to readiness-for-discharge

Patient and surgical characteristics found to be associated with longer time to readiness-for-discharge from the PACU are shown in Table 3. Older age was a significant factor for longer time to readiness-for-discharge (p=0.007). Paediatric patients had the shortest median time of 40 minutes, while the age group of 80 or more years had a median time of 59 minutes. Patients with higher acuity (ASA score of 3 or 4), had longer times to readiness-for-discharge compared to patients with an ASA score of 1 or 2; however, this was not statistically significant at a level of 5 per cent (p=0.056). There was no significant difference in time to readiness-for-discharge from the PACU based on gender (p=0.630) or study site (p=0.220).

Time to readiness-for-discharge was significantly correlated with duration of surgery where longer duration of surgery had a positive correlation with a longer time to readiness-for-discharge (r_s= 0.396). The median duration of surgery was 42 (IQR 21–76) minutes. Significant differences (p ≤0.001) in time to readiness-for-discharge from the PACU were also found according to surgical classification, specialities and anaesthesia technique used. Patients undergoing major surgery had a longer median time to readiness-for-discharge than patients undergoing minor surgery (62 vs 40 minutes). The oral and maxillofacial speciality had the shortest median time to readiness-for-discharge (35 minutes) and the neurological speciality had the longest median time (72 minutes). Patients who had local anaesthesia with sedation had the shortest median time to readiness-for-discharge (25 minutes). The median time to readiness-for-discharge for patients who were administered general anaesthesia alone was 47 minutes compared to 58 minutes for patients who were administered spinal anaesthesia alone. The longest median time to readiness-for-discharge was 69 minutes for patients who had general anaesthesia and regional anaesthesia combined.

Clinical factors found to be associated with longer time to readiness-for-discharge from the PACU are shown in Table 4. Seven percent (n=18) of patients reported mild pain, 28.7 per cent (n=70) moderate pain and 8.6 per cent (n=21) severe pain in the PACU. Patients reporting moderate or severe pain had a median time to readiness-for-discharge of 68 minutes; significantly (p<0.001) longer than patients with nil or mild pain with a median of 40 minutes. Half (50.4%, n=124) of the patients received analgesics in PACU. Analgesics administered were opioids (86.3%, n=107), paracetamol (49%, n=61), nonsteroidal anti-inflammatory drugs (4%, n=5) and other adjuncts such as gabapentin and clonidine (7.2%, n=9). Patients who were administered opioids in the PACU had a significantly longer median time to readiness-for-discharge compared to those who did not (65 vs 35 minutes; p=<0.001). For a patient who experienced post-operative nausea and vomiting (PONV), the median time to readiness-for-discharge was

Table 3: Patient and surgical characteristics with associated time to readiness-for-discharge from the PACU

	All patients N=244 n (%)	Readiness for discharge (minutes) Median [IQR]	p value*
Study site			0.220
site A	172 (70.5)	46 [32–70]	
site B	72 (29.5)	52 [35–74]	
Sex			0.510
female	121 (49.6)	48 [35–70]	
male	123 (50.4)	47 [32–70]	
Age (years)			0.007
<18	16 (6.6)	40 [29–45]	
18–39	68 (27.9)	40 [32–63]	
40–59	74 (30.3)	50 [35–70]	
60–79	68 (27.9)	60 [37–85]	
80+	18 (7.4)	59 [32–60]	
ASA score			0.056
healthy/mild systemic disease (ASA-1 and ASA-2)	185 (75.8)	45 [33–69]	
severe systemic disease (ASA-3 and ASA-4)	59 (24.2)	58 [36–85]	
Surgical classification			<0.001
minor	143 (58.6)	40 [30–55]	
major	101 (41.4)	62 [47–85]	
Surgical specialty			<0.001
OMF	28 (11.5)	35 [30–43]	
plastics	13 (5.3)	42 [30–60]	
ENT	16 (6.6)	45 [40–60]	
urology	36 (14.8)	46 [31–63]	
gynaecological	16 (6.6)	50 [44–69]	
orthopaedic	90 (36.9)	55 [35–72]	
vascular	9 (3.7)	60 [30–90]	
general	30 (12.3)	68 [35–87]	
neurological	6 (2.5)	72 [60–83]	
Anaesthesia technique			<0.001
local anaesthesia with sedation	7 (2.9)	25 [17–31]	
GA	204 (83.6)	47 [33–70]	
spinal anaesthesia	12 (4.9)	58 [46–71]	
GA with regional block	21(8.6)	69 [44–83]	

*Mann–Whitney U test for two groups and Kruskal–Wallis test for more than two groups; ASA = American Society of Anaesthesiologists; OMF = oral and maxillofacial; ENT = ear, nose and throat GA = general anaesthesia

significantly longer (p=0.001) than for those who did not experience PONV (79 vs 46 minutes). Similarly, when a patient was hypothermic on arrival into PACU, the median time to readiness-for-discharge was significantly longer compared to a patient who was normothermic (55 vs 44 minutes; p=0.007) (see Table 4).

Complex recovery from anaesthesia was indicated by a documented medical consultation in the PACU and occurred for 22.5 per cent (n=55) of patients. The median time to readiness-for-discharge from the PACU was significantly longer for those patients who had a medical consultation in the PACU compared to those who did not (81 vs 45 minutes; p<0.001). The most common reasons for PACU nurses to request a medical consultation were related to pain management (30.9%, n=17/55) and blood pressure irregularities (25.5%, n=14/55), while 14.5% (n=8/55) of patients required medical consultation for respiratory distress. Some patients (21.8%, n=12/55) required medical consultation for other clinical reasons including neurological changes (n=3), blood loss (n=2), severe PONV (n=2), low urine output (n=2), urine retention (n=1), chest pain (n=1) and incomplete reversal of neuromuscular blockade (n=1). The remaining four patients (7.3%) required medical consultations for non-clinical reasons such as completion of documentation.

Identifying factors using negative binomial regression

Factors that remained independently significant for longer stay in the PACU, without including system delays, were identified by negative binomial regression of time to readiness-for-discharge from the PACU (Tables 5a and 5b). The nine variables found to be significantly associated with time to readiness-for-discharge were included in the analysis. Age, medical consultation in the PACU, PONV, administration of opioids, duration of surgery, surgical classification, pain and hypothermia remained significant predictors at a level of p<0.2 in the multivariable regression model (Table 5a). ASA score (p=0.992) was not an independent predictor and was not included in the final model. The final multivariable regression model and corresponding exponentiated model are detailed in Table 5b. The final analysis suggested potentially five independent predictors of time to readiness-for-discharge. Compared to the reference group of patients aged 18–39 years, those aged 60–79 years appear to have a 16.5 per cent increase in the time to readiness for discharge. If a medical consultation was required in PACU, time to readiness-for-discharge increased by 41 per cent. If a patient had PONV or if opioids were administered, time

Table 4: Clinical factors and complex recovery indicators with associated time to readiness-for-discharge from the PACU

	All patients N=244 n (%)	Readiness for discharge (minutes) Median [IQR]	p Value**
Pain in PACU* (n=242)			<0.001
nil–mild	152 (62.8)	40 [30–58]	
moderate–severe	90 (36.2)	68 [50–85]	
Analgesia in PACU			<0.001
Yes	124 (50.8)	60 [45–80]	
No	120 (49.2)	35 [30–50]	
Opioids administered			<0.001
Yes	106 (43.4)	65 [50–85]	
No	138 (56.6)	35 [30–50]	
PONV in PACU			<0.001
Yes	20 (8.2)	79 [55–104]	
No	224 (91.8)	46 [33–67]	
Hypothermia on arrival to PACU (n=241)			0.007
Yes	106 (44.0)	55 [40–76]	
No	135 (56.0)	44 [32–65]	
Medical consultation in PACU			<0.001
Yes	55 (22.5)	81 [47–100]	
No	189 (77.5)	45 [32–60]	

*Maximum pain score recorded in PACU: 0–3 = nil–mild; 4–10 = moderate–severe
**Kruskal–Wallis test

Table 5a: Negative binomial regression models for time to readiness-for-discharge from the PACU

Readiness for discharge (minutes)	Univariate (N=244)			Multivariable model (N=239)		
Variable	Coeff	95% CI	p-value	Coeff	95% CI	p-value
Age (years)						
<18 years	-0.27	-0.54, -0.01	0.043	-0.17	-0.39, 0.04	0.113
18–39 years (ref)	0			0		
40–59 years	0.13	-0.03, 0.29	0.112	0.08	-0.05, 0.22	0.214
60–79 years	0.24	0.08, 0.40	0.003	0.12	-0.03, 0.26	0.111
80+ years	0.08	-0.17, 0.33	0.546	0.08	-0.15, 0.30	0.496
Medical consultation in PACU	0			0		
Yes	0.47	0.33, 0.60	<0.001	0.32	0.19, 0.44	<0.001
PONV in PACU	0			0		
Yes	0.40	0.18, 0.62	<0.001	0.18	-0.01, 0.36	0.061
Opioids administered in PACU	0			0		
Yes	0.46	0.35, 0.57	<0.001	0.19	0.04, 0.35	0.015
Duration of surgery (minutes)	0.004	0.002, 0.005	<0.001	0.001	0.000, 0.003	0.011
Surgical classification						
Minor (ref)	0			0		
Major	0.37	0.26, 0.49	<0.001	0.1	-0.02, 0.22	0.087
ASA score						
ASA-1 and ASA-2 (ref)	0			0		
ASA-3 and ASA-4	0.17	0.02, 0.31	0.023	0	-0.13, 0.13	0.992
Pain in PACU (N=242)						
nil/mild (ref)	0			0		
moderate/severe	0.42	0.30, 0.54	<0.001	0.14	-0.02, 0.31	0.084
Hypothermia on arrival to PACU (N=241)	0			0		
Yes	0.12	-0.01, 0.24	0.066	0.08	-0.01, 0.18	0.096
Constant				3.54	3.43, 3.66	<0.001

Coeff = beta coefficient; PACU = Post Anaesthesia Care Unit; PONV = post-operative nausea and/or vomiting; ASA Score = American Society of Anesthesiologists physical status classification system score

to readiness-for-discharge increased by 24 per cent and 36 per cent respectively (when adjusted for other factors in the model). For every one minute increase in duration of surgery, the time to readiness-for-discharge increased by 0.2 per cent (see Table 5b).

Discussion

The findings from this study have distinguished factors associated with time to readiness-for-discharge from the PACU from total length of stay in the PACU that typically includes system delays, thus reflecting more clearly the clinical parameters associated with patient flow.

The median time to readiness-for-discharge was 48 minutes and median total LOS in the PACU was 66 minutes. The average total LOS in the PACU for all patients was 73.3 (SD 36.6) minutes, with a range of 15 to 215 minutes. This compares favourably with previously reported average total LOS between 78 and 120 minutes.[8,14,22–24] There is variability in what is considered a prolonged LOS in the PACU.[8,9,22,23,25] The findings of the current study are more representative of patient flow within a large hospital PACU as adult and paediatric patients were included as well as both major and minor surgeries. Most previous studies have reported one patient group or surgical procedure.

The median system delay was ten minutes (IQR 5–25) and 33 per cent of patients had a system delay of greater than 20 minutes. The focus on time to readiness-for-discharge from the PACU, rather than the overall LOS, allowed the factors associated with clinical readiness to be explored. This is an important distinction because system delays can be unique to particular organisational resources and processes that may need local solutions.[8,14,17,18] For example, we found that use of a transport nurse significantly reduced system delays by 33 per cent from a median of 15 to ten minutes.

The association between age and LOS in the PACU is not a consistent finding in previous studies. In a qualitative study, nurses felt that the duration of stay in PACU was related to patients' physiological score and comorbidities and the increased vigilance required[26] rather than age alone. Patients with higher ASA scores, indicating higher

Table 5b: Final multivariable model and exponentiated model for time to readiness-for-discharge from the PACU

Readiness for discharge (minutes)	Final multivariable model (N=239)			Exponentiated model (N=239)		
Variable	Coeff	95% CI*	p-value	Exp(b)	95% CI*	p-value
Age (years)						
<18 years	-0.172	-0.36, 0.02	0.076	0.842	0.70, 1.02	0.076
18–39 years (ref)	0			1		
40–59 years	0.116	-0.02, 0.25	0.099	1.124	0.98, 1.29	0.098
60–79 years	0.153	0.02, 0.29	0.028	1.165	1.02, 1.33	0.028
80+ years	0.102	-0.09, 0.30	0.309	1.108	0.91, 1.35	0.309
Medical consultation in PACU	0			1		
Yes	0.34	0.19, 0.49	<0.001	1.407	1.21, 1.63	<0.001
PONV in PACU	0			1		
Yes	0.22	0.04, 0.40	0.019	1.245	1.04, 1.49	0.019
Opioids administered in PACU	0			1		
Yes	0.31	0.20, 0.42	<0.001	1.361	1.22, 1.52	<0.001
Duration of surgery (minutes)	0.002	0.001, 0.003	0.001	1.002	1.001, 1.003	0.001
Constant	3.58	3.47, 3.69	<0.001			

Coeff = beta coefficient; Exp(b) = exponentiated beta coefficient; PACU = Post Anaesthesia Care Unit; PONV = post-operative nausea and/or vomiting.

*Robust standard errors used to determine 95% CI (confidence interval)

relative risk, are known to have longer stays in the PACU.[8,9] Previous studies have demonstrated that longer duration of surgery has higher odds ($p<0.001$) of longer stay in the PACU[8] with a significant correlation between LOS in the PACU and surgical duration ($rs=0.013$; $p=0.010$).[9] Longer time to readiness-for-discharge was also significantly associated with complicated events in the PACU where medical consultation was required, including clinical deterioration, respiratory distress, alterations in blood pressure, dysrhythmias, altered conscious state and blood loss. These clinical and complicated events require interventions and evaluation of the care provided, such as airway support, analgesia, active warming or antiemetics.[6] A complex recovery or adverse events in PACU have been shown to be associated with increased LOS in the PACU and in hospital[13,27] and increased risk of clinical deterioration on the ward.[7,14,15]

Post-operative pain management and control of PONV that includes assessing, monitoring and providing medication are key roles of the PACU nurse.[5] In a study of patients undergoing hernia repair or cystoscopy in the USA, pain, PONV and delay in voiding were noted as being the top three reasons for a longer stay in the PACU.[28] Ganter et al.[17] found that if a patient was pain free and had no PONV, the stay in the PACU was half that of patients who were vomiting and had severe pain on arrival to the PACU. While the incidence of PONV in the current study was low, the association with longer stay in the PACU for those patients with PONV remains. The findings showed an increase in time to readiness-for-discharge of 24 per cent associated with PONV and 36 per cent with administration of opioids. Although administration of opioids in PACU was an independent predictor of longer time to readiness-for-discharge, the site-specific protocols associated with the time patients need to remain in PACU after the use of opioids are likely to have contributed to the longer stay in PACU. The use of prophylactic anti-emetics and analgesics during surgery is recommended.[29]

Hypothermia increases the risk of adverse events such as surgical site infections, bleeding and cardiac events as well as negatively affecting patients' experience of comfort.[30,31] A Brazilian study showed that oncology patients, undergoing general surgery, had a significantly longer LOS in the PACU if they had a low temperature.[32] In our univariate analyses moderate to severe pain and hypothermia were significantly associated with increased time to readiness-for-discharge from the PACU. In the final regression model however, hypothermia was not an independent predictor of longer time to readiness-for-discharge. Further research is needed to fully understand the relationships between factors associated with hypothermia and processes of care that may contribute to hypothermia in patients arriving in the PACU. Nevertheless, the findings highlight the clinical importance of prevention and treatment of hypothermia in the operating suite for the optimal care of the patient.

A clearer understanding of non-modifiable and modifiable characteristics associated with time to readiness-for-discharge from PACU can inform planning and scheduling of operating lists and anticipation of patient flow. In addition, this understanding can focus the clinical care of patients in PACU on pre-operative assessment, intra-operative care and the early recognition and management of PONV, pain and clinical deterioration.

Strengths and limitations

The study had limitations relating to the single case study design and use of retrospective medical record data. A single case study design does not allow for external validity and lacks generalisability. However, this study has provided a rich account of factors that impact on patient flow through the PACU at a large private health service provider where almost 40 000 surgical procedures are conducted per year. The use of retrospective medical record data is known to contribute to selection and recall bias. This study used a rigorous random selection process and excluded cases where more than ten per cent of variables were missing data. The factors that were associated with system delays were difficult to report due to lack of documentation and the retrospective nature of the study. It was noted that the receiving unit may be an important factor in longer stay in the PACU but this is an area for future research. The strengths of this study included the full real-world sample of cases in the throughput of the two sites, such as both adults and paediatric as well as elective and emergency cases.

Conclusions

The findings of this exploratory study have identified modifiable and non-modifiable patient, surgical and clinical factors associated with a longer stay in the PACU, in particular, time to readiness-for-discharge. Older age, higher acuity, longer duration and major surgery, neurosurgical specialty, general anaesthesia with regional block, PONV, moderate to severe pain and administration of opioids, hypothermia on arrival to PACU and need for medical consultation in PACU were all associated with an increase in time to readiness-for-discharge. Age, duration of surgery, PONV, administration of

opioids in PACU and need for medical consultation remained independent predictors of time to readiness-for-discharge in multivariable analyses.

Implications for perioperative practice

This study provides a focus for the clinical care of patients in the PACU. The review of scheduling to account for older patient age and longer duration of surgery may assist to predict the patient flow in and out of the PACU. Prevention, early recognition and prompt treatment of PONV, clinical deterioration and pain are vital in perioperative clinical care and reduce time in the PACU. Prophylactic measures such as the use of antiemetics and multimodal analgesia to minimise PONV and post-operative pain may reduce the incidence and, in turn, reduce the time to readiness-for-discharge. Recognition and response to clinical deterioration and requirements for medical consultation are also independent factors that require the PACU nurse to be vigilant and prompt in assessment and actions to reduce the length of stay. Understanding the factors associated with longer stay facilitates nursing management of staffing levels and patient flow within the PACU, to improve the quality of care provided.

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Awareness under anaesthesia: The role of the perioperative nurse

Abstract

Intra-operative awareness is very rare yet represents a serious complication of general anaesthesia. The ongoing consequences of such an event may cause significant distress and long-term effects such as insomnia, depression, anxiety and post-traumatic stress disorder (PTSD). To provide safer anaesthesia, it is critical to identify contributing factors related to both the patient and the anaesthesia to prevent intra-operative awareness in at-risk patients. It is also vital to provide education to Post Anaesthesia Care Unit (PACU) nurses and surgical ward nurses about the appropriate way to manage a situation when a patient reports intra-operative awareness following anaesthesia.

General anaesthesia with neuromuscular blockade is still considered the highest risk factor for intra-operative awareness. Depth of anaesthesia monitoring has come under the spotlight to try and address this complication; however, there is yet to be a device or technique that provides 100 per cent accuracy in measuring depth of anaesthesia.

It is the collective responsibility of all perioperative staff to identify patients at high risk of intra-operative awareness, manage the intra-operative complexities and offer support and expert counselling post-operatively when intra-operative awareness is reported.

Keywords: intra-operative awareness, recall, depth of anaesthesia monitoring, perianaesthesia, BIS, entropy, PACU nursing

Introduction

Intra-operative awareness is defined as 'post-operative recall of events during the period of general anaesthesia'.[1(p.115)] It is a distressing complication of anaesthesia where patients have reported paralysis, hearing intra-operative conversations, feeling surgical manipulations and sometimes pain, with associated feelings of being helpless and afraid.[2]

The fear of intra-operative awareness is second only to that of post-operative nausea and vomiting.[3] With the introduction of neuromuscular blockade, the significance of a patient being able to move (such as raising a hand or arm) as evidence of adequate anaesthesia has been significantly diminished; the first reported case of insufficient anaesthesia was reported in 1950.[4] The incidence of intra-operative awareness is estimated to be between 0.1 and 0.2 per cent,[5] with 10 to 25 per cent of cases considered to be associated with adequate anaesthetic dosing.[6] Clinical signs, such as elevated blood pressure and elevated heart rate, do not always occur in patients with awareness[2] thus using these signs as monitoring for depth of anaesthesia are unreliable.[6]

While the reported incidence of awareness may be considered low, some clinicians suspect intra-operative awareness is grossly underreported.[7] Intra-operative awareness can have significant, long-term and long-lasting effects on patients, such as anxiety, sleep

disturbances and PTSD.[3] Techniques to measure the depth of anaesthesia have come under the spotlight in an attempt to further reduce this phenomenon. There have been advances in technology, such as the forehead electroencephalogram (EEG) monitors, bispectral index (BIS) monitoring and entropy monitoring.[3] However, there is still no one modality that offers 100 per cent accuracy and reliability in determining the depth of anaesthesia.[1]

Following extensive reading on this subject, three themes emerged: risk factors for adult patients, depth of anaesthesia monitoring and detection of post-operative awareness. This discussion paper will present information on awareness under these themes and discuss implications for perioperative nurses and how they can advocate and care for patients who suffer this serious complication.

Risk factors for adult patients

Published studies divide risk factors, or predictors, into patient and anaesthesia factors.[7] Patient factors include previous episodes of awareness, anxiety, genetic mutations, being female and being young.[8] However, Sleigh et al. suggest that the awareness with recall phenotype is only shown when patients are receiving anaesthesia, thus too late for any preventative measures.[6] Other contributing patient factors include alcohol or drug abuse, chronic pain and long-term opioid use, metabolism-enhancing medications, anti-retroviral medications and high dose betablockers.[9]

One theme arising from research is whether a correlation exists between high pre-operative anxiety levels and an increased risk for intra-operative awareness.[1,10] In research by Altinsoy et al. researchers conducted a prospective, observational, cross-sectional study (n = 799) that involved administering a pre-operative anxiety screening tool known as the state trait anxiety inventory, which is widely used and accepted as the gold standard for determining anxiety.[10] While the results of the study did not show definitive links, results did demonstrate that patients with high scores in their pre-operative anxiety testing belonged to similar cohorts to those considered high risk for intra-operative awareness, suggesting this may be an avenue for future research.[10] These sentiments are echoed by Odor et al. who suggested routine pre-operative anxiety testing should become standard pre-operative anaesthesia practice, as it is only through evaluating data, assessing risk factors and understanding which patients are at high risk that a fuller and broader understanding of this phenomenon can occur.[11]

Anaesthesia factors are the use of total intravenous anaesthesia (TIVA) and neuromuscular blockade (NMB) agents[8] with the use of NMB agents representing the greatest risk factor for intra-operative awareness.[11] While intra-operative awareness can still occur using volatile anaesthesia, the additional monitoring parameters of minimum alveolar concentration and end-tidal gas analysis may reduce the incidence.[12]

Depth of anaesthesia monitoring

The Australian and New Zealand College of Anaesthetists (ANZCA) 'PG18(A) Guideline on monitoring during anaesthesia' advocates for the use of equipment to monitor the effects of anaesthesia on the brain, when clinically indicated or for those patients who are considered high risk for awareness.[13] As early as the 1930s, it was postulated that EEG monitoring could be used to determine anaesthetised states.[14] Monitoring patients' clinical signs was always considered an appropriate measure for assessment of the depth of anaesthesia monitoring[15] until the early 1990s when forehead sensors such as BIS and entropy monitors were introduced into anaesthesia practice as new depth of anaesthesia (DOA) monitoring.[16]

The BIS monitor is predominately used for DOA monitoring in Australia.[17] BIS monitors have a forehead sensor that is placed on the patient and connected to a monitor, measuring the EEG signals of the brain.[16,18] Through sophisticated algorithms, the monitor interprets the EEG signal and provides a numerical value between 0 and 100 with 90–100 considered fully awake.[16,18] A value of less than 60 is considered asleep, with some surgeries requiring lower numerical values.[14] The use of a BIS monitor in conjunction with clinical sign assessment may be a valuable tool in assisting with the assessment of depth of anaesthesia and in preventing recall.[14] A criticism of BIS monitors is that they are slow to respond to changes after administration of anaesthesia, taking approximately 10 seconds to interpret and respond to changes in EEG activity.[3]

Entropy monitors process both EEG and frontal electromyography (FEMG) data, converting these signals to give two numerical values state entropy (SE) and response entropy (RE).[19] RE is based on both EEG and FEMG signals and provides an indication of a patient's responses to external stimuli as well as possibly signalling early awaking.[19] The SE is a stable parameter based on EEG and can be used to assess the hypnotic effect of anaesthetic agents on the brain.[19]

RE is always higher or equal to the SE value.[19] Due to the RE parameter entropy monitoring responds to changes in stimuli in about two seconds; however, as it measures FEMG signals it is not useful in patients who are not paralysed or have underlying nervous conditions such as Parkinson's disease.[19]

The B-Aware trial was the salient research conducted on awareness by Myles et al. using a prospective, randomised, double-blind multicentre trial where adult patients (n = 2463) at high risk for intra-operative awareness were randomly allocated to either a clinical care group (n = 1238) or a BIS-guided anaesthesia group (n = 1225).[2] There were two reports of awareness in the BIS-guided anaesthesia group, and 11 reports in the routine care group (p = 0.022), indicating that BIS-guided anaesthesia reduced the risk of awareness by 82 per cent (95% CI 17–98%).[2] Since this research in 2004, some studies have supported the B-Aware trial findings[9,12,18] while others have not[8,16,20] revealing that evidence supporting the use of brain monitoring is conflicting.[15] As with any tool or monitoring device, there are limitations to the use of EEG-based monitoring, including connectivity of the forehead sensor.[21]

The detection of post operative awareness

It is currently unknown how long someone must experience an episode of intra-operative awareness to generate a memory that can be recounted after general anaesthesia.[11] An additional gap in knowledge is the effect that general anaesthesia may have on perceptual and episodic memory.[11] This is why post-operative interviews are considered important in detection of intra-operative awareness.[11,22]

Bombardieri et al. conducted post-operative interviews with 17 875 patients from multiple sites within a single health service who were considered high risk for intra-operative awareness.[22] Of the participants 622 reported a specific intra-operative memory that occurred between induction and emergence (3.48%, 95% CI 3.22%–3.78%) with 282 of these reporting a feeling or sensation of pain, paralysis and/or distress (1.58%, 95% CI 1.40%–1.78%).[22] Bombardieri et al. conducted the first interview prior to the patients leaving the PACU,[22] which is different to other studies that conducted the first post-operative interview between day one and day three post-operatively.[5,7,8] Bombardieri et al. found that 50 per cent of the reported cases were detected in PACU.[22] The PACU is the first place where a patient has the 'opportunity to communicate their own thoughts and feelings' post-operatively.[23 (p.193)]

A term occurring in the literature is 'thrice Brice'[11]. This refers to conducting post-operative interviews using a structured or modified Brice questionnaire on three separate occasions.[11] A lower sensitivity in reporting occurred when using unstructured interviews.[7] With the notable exceptions of the studies by Bombardieri et al.[22] and early research conducted in 2000 by Sandin et al.,[24] the literature recommends conducting structured interviews on the following three occasions: first on day one to three post-operatively,[5,7,8,11] second around 10–14 days post-operatively[5,7,8,11] and a final interview at 30 days post-operatively.[5,7,8,11,22] The second interview is highly regarded as the most beneficial in the reporting of intra-operative awareness, with authors suggesting 50 per cent of awareness reports occur at this stage.[11,23,22] A school of thought exists whereby all patients considered high risk should have 'thrice Brice' interviews conducted post-operatively as a means of using holistic measures and in an effort to address the gaps in knowledge.[5, 7,8,11,22,23]

Implications for perioperative nurses

It is the collective responsibility of all members of the perioperative team to understand the risk factors and management of intra-operative awareness.[23] As patient advocates, perioperative nurses have the opportunity to use their expertise and knowledge to identify those patients who may be considered high risk for intra-operative awareness and communicate this to the treating anaesthetist and intra-operative team members.[23] If pre-operative anxiety screening becomes routine practice, the perioperative nurse may play a vital role in administering the questionnaires.[25] Several authors believe the best management of intra-operative awareness is prevention.[1,7,9,11,26]

Anaesthesia nurses are required to have a knowledge base specific to their profession, including knowledge and training in EEG monitoring.[23] Therefore, the anaesthesia nurse, as an essential member of the intra-operative team, allows accurate EEG monitoring by ensuring sensors are correctly placed on the patient's forehead (specific for each different brand of EEG monitor), intra-operatively monitoring changes such as responses to stimuli, and understand what the numerical value signifies.[23] The role of advocating for patients is paramount and, while there is currently no perfect detection method, perioperative nurses can encourage the use of all available detection methods for their patients.

Patients are often afraid to report events of awareness for fear of not being believed or fear of reprisal.[27]

Dealing with these reports requires compassion and involves providing reassurance and psychological and emotional support.[28] Should a patient report an episode of awareness, it is vitally important that the PACU nurse listens to the patient, accepts what the patient is recalling and reassures the patient by reminding them that they are in the PACU, that the procedure is over and that they are now safe.[2] The PACU nurse has a unique opportunity to define this episode of care for the patient[28] and inform both the anaesthetist and their health service organisation immediately about this occurance.[26]

In some health service organisations, perioperative nurses conduct post-operative phone calls and therefore nurses can play an essential role reporting information provided by patients such as intra-operative awareness.[19] If adopted into routine practice for patients considered high risk for awareness, perioperative nurses should be familiar with the 'thrice Brice' practice[11] and, where possible, they may conduct the phone calls,[29] participate in the interviews and compile the survey responses.[19]

Conclusion

Despite the low incidence of intra-operative awareness, it is still an area of particular concern for clinicians working in anaesthesia due to the potentially harmful and long-lasting effects on patients. The perioperative nurse plays an important role throughout all aspects of the patient's perioperative journey in helping to advocate for use of detection monitoring and manage instances of intra-operative awareness that may be reported in the PACU. Research suggests understanding and detection of episodes of intra-operative awareness may be improved through genetic research and testing and pre-operative anxiety screening, both of which may be commonplace in future practice.

Perioperative nurses should be knowledgeable about intra-operative awareness and able to identify patients at risk, understand depth of anaesthesia monitoring and use patient advocacy skills to report and manage incidents of patient intra-operative awareness. It is plausible that perioperative nurses performing a perianaesthesia nursing role may be essential to the emerging trend of genetic testing by conducting blood sampling and implement anxiety screening by administering anxiety questionnaires.

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Where are the practising nurse anaesthetists in Australia? Exploring an advanced practice role for anaesthesia nurses

Abstract

The perioperative environment has seen the implementation of the perioperative nurse surgical assistant as an advanced practice nursing role for the instrument nurse; however, there is currently no recognised equivalent role for the anaesthesia nurse. Anaesthesia nurses complete post-graduate qualifications and learn advanced clinical skills, and yet the authoritative body for perioperative nurses, the Australian College of Perioperative Nurses, does not define a specific role for advanced practice nursing in anaesthesia. Career advancement for the anaesthesia nurse focuses on education and management roles which are a distinct deviation from advanced clinical practice. A new role should be developed to allow the advanced practice nurse in anaesthesia to be recognised and their skills used in Australian operating rooms.

Keywords: nurse anaesthetist, non-medical anaesthesia provider, certified registered nurse anaesthetist (CRNA), advanced practice nurse, anaesthetic nurse, anaesthesia nurse

Introduction

Modern anaesthetic agents, such as nitrous oxide, ether and chloroform, were first used by dentists and physicians in the United States of America (USA) and Great Britain specifically to provide pain relief during dental and medical procedures.[1] Seen as being safer for patients, ether quickly became the preferred anaesthetic agent and, due to its ease of administration, nurses were able to take the lead in administering it.[1] Similarly in France, nurses were trained to administer ether, unsupervised by physicians, to provide anaesthesia for the army during World War II,[2] but it was the American influence that set the stage for nurse anaesthetists to become a bona fide profession in their own right.[1]

In contrast, British nurses were unable to carve themselves a niche in anaesthesia delivery – perhaps due to the British preference for chloroform which was inherently more dangerous and difficult to administer – and the nurse anaesthetist role was lost to physicians.[1] In 2018, Tenedios et al. described the administration of anaesthesia in Britain as being limited to surgeons, physicians and physicians' assistants, to the complete exclusion of nurses.[2] Australia and Britain are two of the countries in a small group that continue to allow nurses to assist with anaesthesia delivery but not to administer it.[1]

In the Australian perioperative environment, the anaesthetic team consists of an anaesthetist and their assistant – an anaesthesia nurse or anaesthetic technician.[3] The anaesthesia nurse is described by the Australian College of Perioperative Nurses (ACORN) as

a dual role providing both nursing care to the patient and quality assistance to the anaesthetist during the critical moments of anaesthesia.[4] The ACORN standard 'Advanced practice nursing and nurse practitioner roles' does not discuss an advanced role for the anaesthesia nurse.[5] The Australian and New Zealand College of Anaesthetists (ANZCA) is the governing body responsible for the training and assessment of anaesthetists; ANZCA's current stance is that delivering anaesthesia is a medical role that requires completion of a specialty anaesthesia training program.[6] While ANZCA does acknowledge there are benefits for patients related to the inclusion of non-medical personnel with advanced anaesthetic skills in the perioperative team, there is currently no role in Australia that allows anaesthesia nurses to practice anaesthesia with any further autonomy.[6]

Thematic analysis was completed by reading articles until saturation had occurred and no new patterns or ideas were emerging. This discussion paper will examine this topic under the following themes: the anaesthesia nurse, advanced practice nursing in the perioperative environment, international models for nurse anaesthetists, an Australian model for advanced practice anaesthesia nursing, career progression for the anaesthesia nurse and barriers to implementation.

Discussion

The anaesthesia nurse

ACORN and ANZCA guidelines require the anaesthetic assistant to meet the criteria in the ANZCA professional standard PS08 'Position statement on the assistant for the anaesthetist'.[3,4] This position statement states that training must include education in several core competencies and a combination of assessments and practical experience.[3] Once these requirements have been met the nurse assistant must also participate in continuous anaesthesia-specific professional development in addition to meeting their annual registration requirements to practice in this role.[4,7] While anaesthesia nurses can choose to undertake postgraduate study and complete advanced skill certifications through organisations such as the Australian College of PeriAnaesthesia Nurses (ACPAN),[8] there is no defined advanced practice nursing role directly linked to formal education for the anaesthesia nurse to progress to in the Australian perioperative environment.[5] Other avenues of career advancement lead into management and education roles which involve a reduction in clinical practice – a study by Nurmeksela et al. found that clinical duties were described as the activity performed least in the day-to-day nurse manager role.[9]

Advanced practice nursing in the perioperative environment

An advanced practice nurse has acquired an expert knowledge base, complex decision-making skills and additional clinical competency through the completion of further education.[10,11] In the perioperative environment, the experienced instrument nurse can pursue additional education and qualify for the role of the perioperative nurse surgical assistant (PNSA), which allows them to assist with performing surgical interventions and provide enhanced pre- and post-operative care under the supervision of the surgeon.[11,12] ACORN describes the PNSA as a registered nurse who practices at an advanced level to provide extended perioperative nursing care.[5] This non-medical surgical assistant role is seen as a direct extension of the instrument nurse role.[11] Qualification as a PNSA can be gained as part of a Master of Nursing or as a tertiary short course for registered nurses who have previously completed a Master of Nursing.[13] Despite confusion about the scope of practice and remuneration for the PNSA, Haines and Smith describe non-medical clinicians as being valuable in the perioperative space, particularly where there is limited access to medical practitioners.[12] Given that this advanced practice nursing avenue already exists for the instrument nurse, it seems reasonable to consider an advanced practice role for the anaesthesia nurse to allow an equal opportunity for career development.

International models for nurse anaesthetists

The USA and Europe both provide a greater scope of practice for nurses and other non-medical anaesthesia providers in roles such as nurse anaesthetist, anaesthesiologist assistant and physician assistant who are able to deliver anaesthesia under the supervision of an anaesthetist.[6,14] A 1999 seminal study by McAuliffe and Henry aimed to provide a baseline of data for nurse-delivered anaesthesia worldwide.[15] McAuliffe and Henry reported that nurses were delivering anaesthesia in 107 countries and performing tracheal intubation, regional anaesthesia and intra-operative management, either independently or under the direct or indirect supervision of medical anaesthesia providers.[15] In many low-income countries such as Ethiopia, Kenya and Liberia, non-physician anaesthesia providers are the sole anaesthesia provider available and deliver safe anaesthetic care to thousands of patients every year.[10,16] The American Association of Nurse Anesthesiology (AANA) state that in the USA Certified Registered

Nurse Anaesthetists (CRNAs), who have been credentialled since 1956, administer more than 50 million anaesthetics per year and represent 80 per cent of the anaesthesia providers in rural America.[17]

An Australian model for advanced practice anaesthesia nursing

In Australia, one avenue of further education for anaesthesia nurses is a postgraduate certificate or diploma, followed by a master's degree specialising in anaesthetic nursing.[18] Anaesthesia nurses may also choose to pursue advanced clinical skills certifications through professional organisations such as ACPAN. However, none of these qualifications leads to a recognised advanced anaesthesia nursing practice role in the perioperative environment.[5] To proceed with the development of an advanced practice role in Australia the educational requirements described by the International Federation of Nurse Anesthetists (IFNA) would need to be carefully examined.[19] In 2021 the International Council of Nurses (ICN) released the Guidelines on Advanced Practice Nursing Nurse Anesthetists that were developed in collaboration with the IFNA.[10] These guidelines aim to support the nurse anaesthetist role in assisting with the ambitious World Health Organization aim of ensuring that five billion people around the world will be able to access safe and affordable surgical and anaesthesia care by 2030.[10] These guidelines also require the nurse to complete a master's level qualification in anaesthesia education that includes clinical practice, a thesis and a comprehensive examination process to practice as a nurse anaesthetist.[10] There is currently no comparable master's course available in Australia; and, when planning an advanced anaesthesia nursing practice role, a suitable tertiary institute that would collaborate closely with ACORN and ANZCA would need to be identified.

The ICN guidelines aim to provide clarity for the nurse anaesthetist role, as it develops, and assist organisations with creating policies and frameworks to support the governance and practice of nurse anaesthetists.[10] The ICN describes nurse anaesthetists as caring for patients during every step of the perioperative journey, and their scope of practice includes performing pre-anaesthesia assessment; prescribing pre-medication; administering anaesthetic drugs, fluids and blood products; managing perioperative complications; facilitating emergence from anaesthesia, and managing post-operative pain.[10] An Australian model of advanced practice anaesthesia nursing would need to be developed from the ICN guidelines working closely with all relevant parties to ensure that the role has a clear credentialing process and appropriate professional standards to work within. A scope of practice that enables the anaesthesia nurse to work collegially with specialist anaesthetists as a valued member of the anaesthesia team would also need to be carefully developed and negotiated with all stakeholders.

In an older Australian trial, the Royal Adelaide Hospital incorporated physician assistants into their perioperative anaesthesia care team to perform pre-anaesthetic assessment and treatment of patients with significant medical comorbidities who did not meet the requirements to be seen in 'high risk' clinics.[20] Data from 231 patients examined by an external evaluation agent revealed that the physician assistants were able to successfully identify and manage an average of 2.5 medical issues per patient prior to surgery that otherwise would not have been realised until the day of their admission.[20] This improved perioperative efficiency and demonstrated the potential value of incorporating non-medical anaesthesia providers into the anaesthetic team.[20] The Australian advanced practice anaesthesia nurse role could be introduced in a similar way that focuses on specific stages of perioperative care, such as pre-anaesthesia assessment or post-operative outreach. This advanced practice nursing role would have a greater scope of practice, higher level of autonomy and increased critical decision-making than anaesthesia nurses currently have and would remain under the direct or indirect supervision of a specialist anaesthetist, similar to the PNSA working under the supervision of the surgeon.

Career progression for the anaesthesia nurse

With the Department of Health in Australia predicting a shortfall of almost 45 000 nurses in Australia by 2030 as a result of increased demand and a steadily growing attrition rate, retention of experienced nurses is vital to maintain an adequately skilled nursing workforce.[21] Other countries have demonstrated that job dissatisfaction is closely linked to high attrition rates in nursing with Sillero-Sillero and Zabalegui finding that 20 per cent of perioperative nurses in a large Spanish public hospital would resign if the chance arose, with 94.9 per cent citing dissatisfaction with professional development opportunities as one of the main reasons for overall job dissatisfaction.[22] A study of 113 Canadian perioperative nurses by Lee et al. also found that decreased job satisfaction was strongly linked to the intention of nurses to leave the profession.[23]

A survey of 1365 Australian nurses conducted in 2013 found that a lack

of career options was also one of the main reasons for job dissatisfaction among nurses in Queensland.[24] In this study 13.8 per cent of nurses were dissatisfied or very dissatisfied with their career progression, with respondents contemplating leaving the profession stating a lack of career advancement and advanced practice nursing roles as the main reasons for dissatisfaction, and that non-clinical roles, such as management, were often the only option for career progression.[24] These figures do not take into account any unanticipated reductions in recruitment from migration which will potentially be significantly affected by the COVID-19 pandemic.[25]

Negrusa et al. examined the findings of the 2019 AANA survey of CRNAs and found that 89 per cent of CRNAs in the USA were satisfied or somewhat satisfied in their job, with a higher level of autonomy listed as a factor associated with increased job satisfaction.[26] Lee et al. also found that strong collegial relationships between perioperative nurses and physicians were strongly linked to higher levels of job satisfaction ($p < .05$).[23] A 2015 study of 24 Australian PNSA course graduates cited professional development, a desire to provide a higher quality of patient care and gaining formal recognition as the main reasons for pursuing the PNSA qualification.[27] Creating an advanced practice role in Australia may allow anaesthesia nurses the same opportunity to provide a higher level of patient care, build greater autonomy and develop more reciprocal clinical relationships with anaesthetists, leading to increased levels of job satisfaction and a higher rate of retention.

Barriers to advanced practice anaesthesia nursing

Future advanced practice anaesthesia nurses can learn from the barriers experienced during the implementation of the PNSA and other non-medical perioperative roles in Australia. In 2012, Willows wrote about his experience as the inaugural PNSA at the Royal Hobart Hospital and described a reluctance to recognise the role, issues with remuneration and hostility from both nursing and medical staff as being significant barriers to implementation, although he found the role itself was greatly rewarding.[11] Hains and Smith discussed how the protectionism of medical roles in the perioperative space limits the opportunities for nurse practitioners as surgical assistants to gain adequate exposure and experience, and work to their full scope of practice.[12] A 2020 study performed by Weinberg et al. in a large Australian hospital found, to the great surprise of the authors, that most specialist anaesthetists did not support a nurse practitioner model for the delivery of sedation for endoscopy procedures, nor were they willing to participate in the training and supervision of nurse practitioners in anaesthesia.[28] Reasons cited were a perceived compromise to patient safety, a potential for increased public liability, reduced opportunities for anaesthetists in training and low consumer acceptance, despite the hypothesised benefits of improved patient access to vital endoscopy services.[28] The 60 specialist anaesthetists who participated in the survey also made it very clear that the development of a model of care that allows non-medical anaesthesia providers to perform sedation would require careful negotiation with ANZCA.[28]

From 2017 to 2018, Australian public hospitals spent 60 per cent of their total funding on wages, with private hospitals in Australia reporting spending just over 49 per cent.[29] In the year 2000, Glance modelled several different staffing scenarios in the US to determine if the cost effectiveness of anaesthesia delivery could be improved by changing the skill mix of anaesthesiologists and CRNAs.[30] This study determined that a model that carefully balances the ratio of physician and non-physician anaesthesia providers according to patient risk would result in more cost effective anaesthesia services without increasing the overall mortality rate, although a larger sample size would be required to validate these findings.[30] With the demand for surgical and diagnostic services in Australia increasing,[29] the addition of a carefully balanced ratio of advanced practice anaesthesia nurses working in collaboration with specialist anaesthetists may provide a more economical way to increase the capacity of the anaesthesia workforce.[30] While the Department of Health in Australia is currently estimating a small oversupply of anaesthetists by 2030, this is based on maintaining current levels of anaesthetist migration and does not take into account the possible effects of the COVID-19 pandemic.[31]

Conclusion

Advanced practice nursing roles in the perioperative environment provide nursing staff with the opportunity to gain formal recognition for knowledge and skills and higher levels of job satisfaction. The current lack of an advanced practice role for anaesthesia nurses needs to be addressed to provide the anaesthesia nurse with professional equity in the Australian perioperative environment. However, advanced practice roles

for anaesthesia nurses in Australia depend heavily on the government, for support, and on regulatory bodies to provide appropriate recognition and remuneration. To be successful and have a meaningful impact on the provision of anaesthesia services in Australia, these advanced practice nurses would also require unwavering commitment from nursing and medical organisations. As long as there continue to be adequate supplies of specialist anaesthetists there will be resistance to the introduction of new roles in anaesthesia and it will be difficult to find a place for the non-medical anaesthesia provider in Australia without genuine and widespread support from the anaesthetist community. Ultimately, the implementation of an advanced practice role for anaesthesia nurses would provide an additional and economical string to the bow of anaesthesia care for patients in Australia.

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Nurse-led randomised controlled trials in the perioperative setting: A scoping review

Abstract

Purpose: Nurses provide care at each phase of the complex perioperative pathway and are well placed to identify areas of care requiring investigation in randomised controlled trials. Yet, currently, the scope of nurse-led randomised controlled trials conducted within the perioperative setting are unknown. This scoping review aims to identify areas of perioperative care in which nurse-led randomised controlled trials have been conducted, to identify issues impacting upon the quality of these trials and identify gaps for future investigation.

Methods: This scoping review was conducted in reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews. Searches were conducted in PubMed, Embase, Cumulative Index for Nursing and Allied Health Literature and the Cochrane Central Register of Controlled Trials, with a date range of 2014–2019. Sources of unpublished literature included Open Grey, ProQuest Dissertation and Theses, Clinical Trials.gov and the Australian and New Zealand Clinical Trials Registry. After title and abstract checking, full-text retrieval and data extraction, studies were appraised using the Joanna Briggs Institute Critical Appraisal Checklist for Randomised Controlled Trials. Data were synthesised according to the main objectives. Key information was tabulated.

Results: From the 86 included studies, key areas where nurses have led randomised controlled trials include patient or caregiver anxiety, post-operative pain relief, surgical site infection prevention, patient and caregiver knowledge, perioperative hypothermia prevention and post-operative nausea and vomiting in addition to other diverse outcomes. Issues impacting upon quality (including poorly reported randomisation) and gaps for future investigation (including a focus on vulnerable populations) are evident.

Conclusion: Nurse-led randomised controlled trials in the perioperative setting have focused on key areas of perioperative care. Yet, opportunities exist for nurses to lead experimental research in other perioperative priority areas and within different populations that have been neglected, such as in the population of older adults undergoing surgery.

Keywords: perioperative, nursing, randomised controlled trial, scoping review

Introduction

Health care providers are facing pressure to provide effective services to an increasing population with often limited resources.[1] This pressure to provide more with less is evident within the provision of perioperative care. As morbidity increases, so does the complexity of surgery and the pressure upon resources in this highly technical, resource-intensive, fast-paced, acute clinical environment.

For most patients, the experience of undergoing a surgical procedure represents a significant life event. During this critical period, health care practitioners are entrusted to advocate for and maintain the safety of patients when they are removed from family and loved ones and unable to speak up for themselves due to anaesthesia.[2] A safe passage through surgery is the highest priority. However, it has been argued that – despite the amount of effort spent on developing interventions and policy in recent years – progress in optimising patient safety in perioperative care has been much slower than anticipated.[3]

Internationally, perioperative care is described in four distinct phases: pre-admission, the immediate pre-operative (pre-anaesthetic) phase, the intra-operative phase (during induction of anaesthesia and surgery itself) and the immediate post-operative phase of care (prior to patients returning to ward areas).[4] This multi-staged pathway necessarily involves care delivered by a range of health care professions: registered and enrolled nurses, surgeons, anaesthetists, technicians, orderlies and radiographers. However, nurses are a consistent presence at all phases of perioperative care and may work in multiple roles, including pre-operative care, anaesthetic assistance, intra-operative (scrub/scout) and immediate post-operative care roles. In some countries, other professions such as registered operating department practitioners (ODPs) take on perioperative roles.[5] However, globally, nurses have a ubiquitous presence in health care teams that provide perioperative care and are uniquely placed to understand critical points of care and patient concerns across the whole perioperative pathway. It is imperative that nurses ensure they are both driving health care improvements and identifying research priorities in this specialised field.

Experimental research underpins the assessment of the effectiveness of interventions, yet it is widely acknowledged that randomised controlled trials (the gold standard of experimental research) are expensive, resource-intensive and time-consuming.[6] It is essential that time and finite resources are well spent on interventions that are effective, safe and acceptable to patients. Resources and funding to conduct research are difficult to obtain, and therefore it is imperative that resources are directed to areas where gaps in experimental research exist. Furthermore, there is a need to ensure that resources are directed toward research that will be conducted in a rigorous manner in order to ensure high quality and reliable findings.

Experimental research in the perioperative setting

The conduct of rigorous, randomised controlled trials (RCTs) is often inhibited by well-known factors such as cost, time and resources. There are also other challenges in conducting research within this complex, multidisciplinary field that are not widely acknowledged. For instance,

many recent systematic reviews and meta-analyses of perioperative care lack sufficient detailed reports of individual elements of care which may impact on or confound outcomes.[7] Perioperative outcomes are influenced by a wide range of factors throughout the pre-operative journey and need to account for the truly multidisciplinary nature of perioperative care, by including nursing as well as medical interventions during each phase of care in study designs.[6,8] Therefore, the complexity of the perioperative pathway needs to be considered in both the design of primary studies and the assessment of these studies via systematic review. Authors have recently questioned the status of RCTsin remaining the 'gold standard' design to inform perioperative decision-making.[8,9] Several authors have suggested that carefully designed before-and-after (observational) studies can be used to inform perioperative decision-making, with the benefit of being less resource-intensive, and more indicative of the feasibility of implementing interventions in actual practice.[8,9] However, well-conducted, RCTsoffer the highest level of scrutiny with the lowest level of bias, and therefore the greatest benefits to our patients, and remain the gold standard of experimental studies.[6]

Nurse-led research in the perioperative setting

The multidisciplinary nature of perioperative care can result in challenges for nurses when trying to implement evidence-based practice change, such as negotiating staff buy-in across large multidisciplinary groups.[10,11] Challenges also exist for perioperative nurses engaging in primary research that is pertinent to the discipline, such as funding. Potential sources of funding for specifically nurse-led research may also be even more scarce given the seemingly limited lack of financial backing for perioperative research both locally and internationally.[12] Yet, the importance of supporting perioperative nurses to undertake research is vital in both facilitating evidence-based change in this domain of care. Nurses must drive research priorities that are relevant to perioperative nursing care.[13] Although perioperative, nurse-led research may be increasing, the extent to which of these are nurse-led perioperative RCTshas not been evaluated.

Methods

Aim

The purpose of this scoping review is to identify in which domains of perioperative care nurses are leading experimental research.

Objectives

The main objectives of the scoping review were the following:

- to identify in which domains of perioperative care nurse-led RCTshave been conducted
- to analyse the issues impacting upon the quality of experimental research undertaken in the perioperative setting
- to identify what, if any, gaps exist in nurse-led experimental research in the perioperative setting, thus identifying priorities for future research.

Design

This scoping review was conducted in reference to the methodology set out by the Joanna Briggs Institute (JBI),[14] with the framework developed by Arksey and O'Malley[15] and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR).[16] The scoping review methodology is appropriate for this question as it facilitates a broad exploration of perioperative care domains in which nurses are researching. This approach has been used successfully in similar reviews that have explored the scope of research undertaken in other specialised areas of health care.[17–20] Scoping reviews are not eligible for registration with PROSPERO.

Search methods

A comprehensive search strategy was undertaken to find both published and unpublished (grey) literature in English from 2014 to May 2019, as per the recommendations for scoping reviews established by Peters et al.[14] Only studies published in English were included due to lack of resources for translation.

Databases for published literature included PubMed, Embase, Cumulative Index for Nursing and Allied Health Literature (CINAHL) and the Cochrane Central Register of Controlled Trials (CENTRAL). The search for unpublished literature utilised OpenGrey, and ProQuest Dissertation and Theses (PQDT). Searches for trials in progress were conducted using Clinical Trials.gov and the Australian and New Zealand Clinical Trials Registry (ANZCTR). Initial searches of PubMed and CINAHL were conducted to refine index terms and keywords, followed by a second search with keywords and index terms across all databases. Finally, perioperative nursing journals (Journal of PeriAnesthesia Nursing, Journal of Perioperative Practice, AORN Journal, Journal of Perioperative Nursing, Perioperative Care and Operating Room Management) were screened for additional RCTsacross the date range.

Initial search terms for CINAHL were as follows:

1. 'perioperative'
2. MH 'Perioperative Care+'
3. MH 'Perioperative Nursing+'
4. MH 'Perioperative Period+'
5. MH 'Pre-operative Care+'
6. MH 'Pre-operative Period+'
7. MH 'Intraoperative care+'
8. MH 'Intraoperative Period+'
9. MH 'Postoperative Care+'
10. MH 'Postoperative Period+'
11. MH 'Post Anesthesia Care+'
12. MH 'Post Anesthesia Care Units+'
13. MH 'Anesthetics+'
14. #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11
15. MH 'Randomized controlled trials+'
16. #12 AND #13.

Inclusion and exclusion criteria

Studies that met the following inclusion criteria were eligible for review:

Population: participants receiving care during one or more phases of the perioperative pathway: pre-operatively, intra-operatively or immediately post-operatively.

Concept (study designs): only nurse-led randomised controlled study designs were included. To enable the identification of these particular trials, in-depth investigation of author names and qualifications were performed for those studies in which details were not listed on the abstract or full text. Other trials were included if known to be led by nursing academics but whose qualifications are not explicitly stated in the citation.

Context: studies focused on perioperative care including the pre-operative, intra-operative or immediate post-operative setting.

Screening and eligibility process

Four reviewers conducted screening of titles and abstracts to identify relevant papers for full-text retrieval (JM, NH, LD, SM). Full texts were then screened for eligibility against the inclusion criteria by the authorship team using a verification form developed for this purpose (see Supplement 1).

Data charting process

A flow chart was generated to indicate the papers included in the review at each stage, as per the PRISMA guidelines (Figure 1).[16] A data charting form was developed to record and extract study characteristics and variables relevant to the review question (see Supplement 2). Pairs of reviewers undertook data extraction independently for each article and a third reviewer mediated where there was a lack of agreement.

Critical appraisal

Studies identified as relevant to the review were assessed for quality using the JBI Critical Appraisal Checklists for Randomised Controlled Trials.[21] While quality assessment is not considered mandatory in scoping reviews, undertaking this process assisted in identifying common issues that influenced or undermined the quality of RCTsin the perioperative setting. Pairs of reviewers also assessed each included study for quality, with disagreements resolved through discussion and consensus. Where agreement was not resolved through this process, an independent third reviewer was used.

Synthesis

Following data extraction and quality assessment, key information from each study was tabulated to assist in determining country of origin, interventions, primary outcomes, surgical population, sample size and funding source (see Supplement 3). Studies were organised according to the primary outcome in order to identify domains of perioperative care. Within each primary outcome, the interventions of interest and the study population assisted in determining gaps in phases of care or where study populations had not been included.

To analyse factors influencing the overall quality of included studies, common quality indicators were synthesised according to the quality assessment checklist where studies had scored poorly.[21] Areas of perioperative care where experimental nurse-led research is appropriate but not yet evident were identified. Data synthesis and analysis were discussed within the authorship team to ensure consensus and that all relevant themes within the review questions were identified. Results are presented in table form, to provide an overview of all included studies as per the data extraction (charting) form.

Results

Eighty-six studies were included in the final review (Figure 1). The included studies were geographically widespread (Table 1). The region of origin with the most included RCTs was North America (n = 28)[22–49] followed by Europe (n=26) ,[50–75] Asia (n=15) ,[76–90] the Middle East (n=7),[91–97] Oceania[98–102] and South America (both n=5).[103–107]

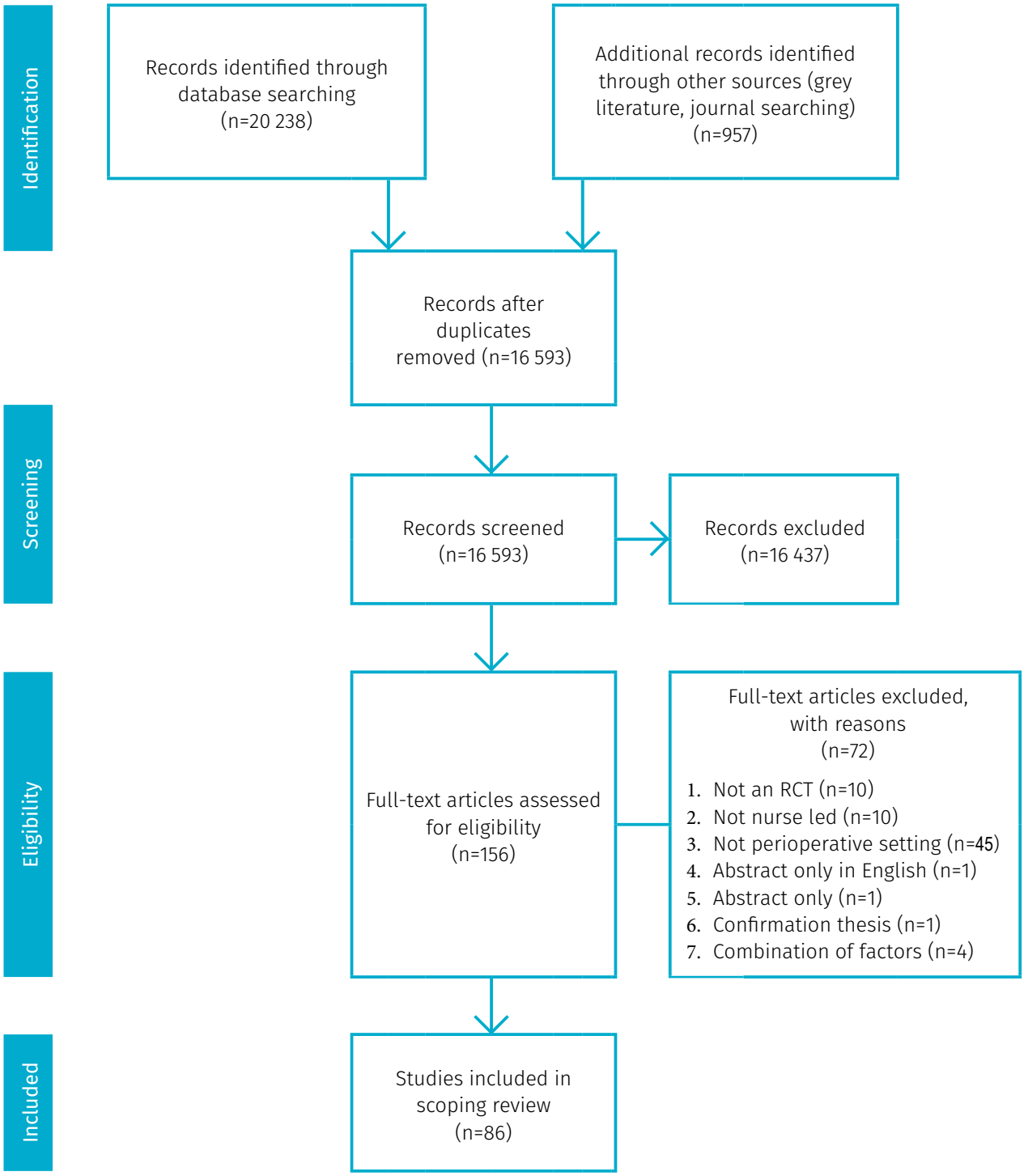

Figure 1: PRISMA flow diagram

Table 1: Randomised controlled trials by country and region

Region Country	Number (n, % of total)
Oceania	
Australia	5 (5.8)
South America	
Brazil	5 (5.8)
North America	
Canada	3
United States of America	25
Total	**28 (33)**
Asia	
China	3
Hong Kong	1
India	1
Singapore	1
South Korea	3
Taiwan	6*
Total	**15* (17)**
Europe	
Croatia	1
Denmark	2
France	1
Greece	1
Italy	4
Norway	1
Spain	3
Sweden	4
Turkey	9
Total	**26 (30)**
Middle East	
Iran	6
United Arab Emirates (UAE)	1
Total	**7 (8)**
Overall total	**86**

Note: *Duplication of one study into two publications noted in this group.

Domains of perioperative care addressed by nurse-led RCTs

Six main domains of perioperative care, addressed by nurse-led RCTs were identified, in addition to other diverse clinical outcomes (see Supplement 3):

1. prevention of caregiver and patient anxiety
2. perioperative hypothermia prevention and temperature monitoring
3. post-operative pain relief
4. post-operative nausea and vomiting (PONV) prevention and treatment
5. prevention of surgical site infection (SSI)
6. patient and parental knowledge.

Prevention of caregiver and patient anxiety

Prevention of anxiety, both from the patient and caregivers' perspective, was the most common primary outcome of interest, accounting for over a fifth of studies (n=20, 23%).[32,37,38,49,53,54,57,58,59,63,70,71,79,81,91,93,94,103,105,108] Prevention of anxiety was a secondary outcome of interest in a further nine (10%) studies.[22,23,25,47,50,55,69,73,80] Of the studies including anxiety prevention as the primary outcome, nine studies (47%) were focused on adult patients,[32,38,53,57,59,71,81,94,105] nine were focused on paediatric patients,[37,49,54,63,79,91,93,103,108] (with four of these also including caregivers as a sub-population[37,49,54,108] and another focused on adolescents[37]) and one study concentrated solely on caregiver (parent) anxiety.[70] The interventions of interest included music[32,58,59,71,103]; education (including videos)[37,70,81,94]; visiting pre-operative facilities[54]; play,[79,91,93,108] relaxation and sounds from nature[57]; aromatherapy[53]; photographic displays[58]; distraction versus midazolam[49]; therapeutic listening[105]; different timings of communication[38] and an application with clown doctors.[63]

Perioperative hypothermia prevention and temperature monitoring

Thirteen published studies (15% of included studies) had a primary outcome of preventing perioperative hypothermia or temperature monitoring.[35,46,56,74,82,85–87,96,98–100,104] However, one study was published twice in two different journals.[85,87] Active warming (comprising forced air, thermal gown, intravenous (IV) fluid warming or underbody warming) and passive warming strategies (reflective versus cotton blankets or cloths) were tested in various combinations. All perioperative hypothermia studies were conducted in the adult population, but within different surgical specialities: interventional cardiovascular procedures,[99] gastrointestinal or thoracic surgery,[85,87] obstetrics,[35,98] laparoscopic cholecystectomy,[96] colorectal surgery,[56] gynaecology,[104] cardiovascular[74] or multiple specialities.[82,100] One study assessed skin temperatures after blankets warmed to different temperatures in a population of healthy volunteers.[46]

Post-operative pain relief

Post-operative pain relief was the third most common primary outcome of interest (n=13, 15% of included studies),[22,24,31,34,36,41,50,51,55,62,65,72,92] and a secondary outcome in 13 studies (15%).[35,40,47,52,60,69,75,76,79,81,86,87] Interventions of interest in the studies where pain was the primary outcome included hypnosis,[55] anaesthetic technique (for hysteroscopy),[51] play,[72] Reiki,[34] premedication and information,[50] different routes of paracetamol administration,[41,62] cold application,[65] guided imagery and

relaxation,[22] positioning and early sandbag removal (post-coronary angiography),[92] room air versus carbon dioxide insufflation,[24,31] and bed positioning.[36] Nine studies had adult participants,[31,34,36,41,50,51,62,65,92] two were paediatric based,[55,72] and one study focused on adolescents.[22]

Post-operative nausea and vomiting (PONV) prevention and treatment

Eleven studies (13% of included studies) focused on the prevention or treatment of PONV. Six studies tested pericardium 6 (P6) acupressure,[29,43,64,69,73,89] two studies tested aromatherapy with or without additional therapies,[39,48] one study tested early hydration,[90] one study tested an individualised pre-operative education intervention[40] and one study tested different doses of promethazine.[44]

Prevention of surgical site infection (SSI)

Five studies (6% of included studies) focused on SSI prevention as the primary outcome, using a variety of interventions: post-operative shampooing,[66] pre-operative 2% chlorhexidine gluconate skin preparation cloths,[42] silver impregnated versus standard dry sterile dressings (cardiac surgery),[26] hair shaving techniques[61] and different antiseptic methods.[88]

Patient and parental knowledge

The primary outcome of interest for five studies (6% of included studies) was patient or parental knowledge.[23,67,80,106,107] Predominantly, these studies tested the effect of video or multimodal education interventions: video resources,[23,80,106,107] multimethod education or information booklets versus questions.[67] Three studies were interested in adult patient knowledge[67,80,106] and two in parental knowledge.[23,107]

Other clinical outcomes

A wide variety of other clinical practices were investigated as primary outcomes in the identified RCTs (see Supplement 3).[25,27,28,30,33,45,47,52,60,68,75,77,78,95,101,102]

Perioperative research populations and phases of care addressed by nurse-led RCT designs

Study populations

Predominantly, studies were focused on the adult population (n= 71, 83%), with ten studies focusing on paediatrics as the population of interest (12%). Four studies included both caregivers and children as the population of interest,[23,47,49,54] while one study focused on caregivers only.[107] Two studies focused on adolescents,[22,37] and one study included both adults and children.[84] Although older adults (>75 years) were included in some studies[52,60,62] they were not specifically identified as the target population in any of the included studies.

Phases of care

Almost half of studies involved interventions that were delivered during the pre-operative phase of care (n=41, 48%), 13 studies delivered interventions during the intra-operative phase (n = 13, 15%),[24,26,31,43,46,51,74,75,86,92,97,99,101] 13 studies (15%) delivered interventions solely in the post-operative phase,[36,39,44,47,48,60,66,68,73,77,82,90,107] eight studies (9%) were based on interventions that were delivered during multiple phases of the perioperative pathway.[34,35,42,56,61,76,85,96] Almost half of the included studies assessed outcomes at multiple phases of the perioperative pathway (n = 34, 40%), while 24 studies (28%) assessed post-operative outcomes extending beyond the immediate Post Anaesthesia Care Unit (PACU) phase.[26,27,34,35,39–41,43,45,48,51,55,61,62,64,66,69,73,89,90,92,99,102,109] Five studies (6%) assessed outcomes only during the pre-operative phase,[57,58,71,103,106] while only four studies assessed outcomes at a single phase of intra-operative care (n=4, 6%),[33,56,59,74] and seven studies assessed outcomes during PACU care only (n=7, 8%).[24,44,47,68,82,100,109]

Issues impacting upon the quality of experimental research undertaken in the perioperative setting

Issues impacting upon the quality of RCTs included in this review were related predominantly to the reporting of blinding techniques. Blinding of participants was unclear or not implemented in 79 per cent of included studies (n=68), blinding of those delivering the intervention was not used or was unclear in 80 per cent (n=69) of studies, and blinding of outcome assessors was not used or was unclear in 73 per cent (n=63) of included studies. Many studies did acknowledge the reasons for lack of blinding and most often this was related to the nature of the intervention under study; yet, most often, lack of blinding of one or more key groups was not discussed or acknowledged as a limitation.

In addition, a lack of, or unclear, randomisation was found in just over a quarter of included studies (35%, n=31). Similarly, a high number of included studies were assessed as having incomplete follow-up or there was inadequate analysis or description of differences between groups (32%, n =28). Duplication of study results was also found in one instance, where the same study was published in different journals with a different author order.[85,87]

Discussion

To our knowledge, this is the first scoping review to investigate the range of nurse-led randomised controlled trials conducted in the perioperative setting. Geographically, this review has revealed that North America contributed the highest number of studies to this review, with the United States of America (USA) the most prolific individual country in terms of conducting nurse-led perioperative RCTs in the last five years. This contrasts with a recent scoping review of RCTs and quasi-experimental studies published in nursing journals, whereby Taiwanese nursing researchers were found to have published the most frequently in nursing journals.[110] However, our review also included studies that, although nurse-led, were published in journals that were not specifically nursing-focused, and only focused on RCTs which was appropriate to address the review question. Similarly, though, our review also found no African studies for inclusion.[110] This may be unsurprising given that a 2015 scoping review of clinical nursing and midwifery research in African countries found that, at the time of the review, most included research was qualitative, and focused on primary or secondary prevention of cancer.[111] Additional obstacles to conduct and publication of nursing research in this region include a lack of resources (including funding, library access, equipment and collaborators) and political and civil unrest.[112]

This review of 86 studies revealed that there are six clearly identifiable areas in which nurses are leading experimental research (specifically RCTs) relevant to perioperative care. The most common primary outcome across included studies was the prevention of anxiety and this was investigated using a range of supportive interventions. Given how commonly pre-operative anxiety is experienced, and the detrimental patient outcomes associated with anxiety,[54,93] this may be justified despite anxiety prevention not being a stated priority by professional associations. The investigation of supportive or complementary therapies may be reflective of the growing interest in complementary therapies in health care more broadly.

The quality issues noted in this review, in which a large proportion of studies assessed the effectiveness of supportive therapies, indicate that nursing researchers are utilising facets of the randomised controlled study design adaptively (and creatively). Given the expense and resources required to conduct RCTs, it is imperative for nurses to ensure that these resources are well spent on trials that are well conducted and provide useful findings. At this stage, it may be pertinent for the focus on anxiety prevention to shift from primary research to translation into practice.

Almost half of the included studies (47%) assessed interventions that were delivered during the pre-operative phase. A moderate number (n=13, 15%) delivered interventions during the intra-operative phase but due to the nature of the interventions and outcomes under study – for example, the focus on anxiety reduction which would be difficult to assess intra-operatively due to anaesthesia – few studies assessed outcomes during the intra-operative phase of care (n=4, 5%). This gap in the literature is an opportunity for nurses to design experimental studies that measure the outcomes of interventions and outcomes related to intra-operative or procedural nursing care. Despite anxiety prevention being the most common outcome in the included studies, one did highlight that further investigation with teens or adolescents is worthy of future study.[54]

While some regions and countries have established perioperative research priorities,[113–115] an international consensus is not evident. The lack of consensus may be influenced by the diverse and differing needs between developed and under-developed regions, but also reflects the variation in the processes used to determine the published perioperative priorities (including the variation in stakeholder involvement). The perioperative pathway is complex, multi-staged and involves numerous health professions in the delivery of care. Therefore, it is logical that any work to establish areas of perioperative care that requires a stronger evidence base needs to ensure multidisciplinary input – as well as ensuring that health care consumers also have input.

In the United Kingdom (UK), the National Institute of Academic Anaesthesia and James Lind Alliance (JLA) Research Priority Setting Partnership's agreed on ten anaesthetic and perioperative care priorities include a range of issues. These range from the study of the term effects of anaesthesia, to establishing 'success' measures for perioperative care.[113] The authors determined that specific care and physiological questions were ranked more highly by clinicians, whereas lay stakeholders ranked communication and long-term outcomes of anaesthesia more highly.[113] Similarly, Biccard et al's Delphi study of perioperative investigators in South Africa, while recognising the need for a co-ordinated perioperative research agenda, established national priorities that focused on a

wide range of quite specific clinical care aspects although lay input into this process was not evident.[115] The failure to investigate outcomes that matter to patients within pragmatic trials is not unique to perioperative care.[6] Nonetheless, the primary outcomes of anxiety prevention and knowledge generation identified in this review align more closely with lay stakeholder-identified priorities related to communication,[26] which may be unsurprising given that patient advocacy is a key nursing role.

This review also found that safety outcomes received minimal attention in the nurse-led trial research included in this review. It has also been argued that safety outcomes, having also been neglected, should also be reported in pragmatic trials in the perioperative setting.[6] Within the perioperative nursing field, Steelman's top ten patient safety priority areas, established by perioperative nurses in the USA, identify only one of the primary outcomes of interest found in the included studies in this review as a safety concern (perioperative hypothermia prevention).[116] However, many of these safety concerns may not lend themselves as a focus of experimental research due to being rare events (for example, wrong-site surgery, prevention of retained surgical items, surgical fires) while others are less so (medication errors, pressure injuries).[116] A number of aspects of perioperative hypothermia prevention are also identified in the Association of periOperative Registered Nurses (AORN) 2019 Research Gaps.[117] The AORN Research Priorities for Perioperative Nursing 2018–2023 focuses on patient education practices as well as the need to improve outcomes for vulnerable populations.[114]

The outcomes from this review of nurse-led RCTs do align, to some degree, with care priorities established by the Australian Government that are published in clinical indicators and guidelines. In the Australian setting, perioperative hypothermia (measured as the number of patients arriving into PACU with a temperature of less than 36° C), pain, PONV, surgical site infection and post-dural puncture headache – all outcomes of interest in the included studies – are key clinical indicators assessed by the Australian Council on Healthcare Standards in the most recent Australasian Clinical Indicator Report: 2010–2017.[118] This report highlights that, for some areas, meeting the key performance indicators has been problematic. For example, in 2017 there was an increased incidence of perioperative hypothermia reported.[118] Therefore, it can be argued that the continued focus on developing strategies to manage this condition is warranted.

All health care professionals leading experimental perioperative research need to ensure that the populations upon which research is focused are reflective of the needs of the surgical populations. As mentioned, no studies specifically focused on the needs of older adults were found in this review. Studies of younger, fitter populations may not be truly reflective of surgical populations outside of trial settings; thus, the practical application of research findings is reduced, and the interests of the older adults receiving surgical care may not be met. This need has been evident over the last ten years. In 2010, a large multicentre, prospective observational study of older adults undergoing surgery in Australia and New Zealand highlighted that complications and mortality among this cohort were prevalent, and strategies were urgently needed to address these issues.[119] However, nurse-led RCTs in the perioperative setting do not reflect the trend of focusing on older adults, and patients with cancer, which were reported more broadly in nurse-led experimental research across clinical settings.[110]

This review has also revealed that common quality indicators are problematic in the conduct of RCTs in this setting. Unclear randomisation was evident across the majority of studies, despite the inclusion criteria only specifying randomised controlled designs. There was a lack of blinding in the included studies. In the studies where blinding was implemented, the method of blinding varied considerably. Successful blinding may have occurred for the participant, those delivering interventions and/or the outcome assessors. While a number of studies acknowledged and provided an explanation for a lack of blinding, many other studies either reported but did not explain, or did not acknowledge the lack of blinding at all. Where acknowledged, most often blinding was not achieved due to the nature of the intervention. This is perhaps unsurprising, given that most of the interventions were delivered and/or outcomes assessed at time points of care where patients were awake. It is acknowledged that interventions such as the use of forced air warming, or some complementary therapies, are extremely problematic when trying to include effective blinding techniques for participants.[99] Nonetheless, bias related to lack of participant blinding may be offset by the assessment of objective outcome measures and the use of outcome assessor blinding, where possible.[120]

Limitations

There is potential that some nurse-led RCTs meeting the inclusion criteria have been inadvertently missed, despite our extensive and thorough search process. The process

of identifying nurse-led studies was complex during the search phase of this review. Not all studies clearly identified the professional background of authors. This meant that additional searches of the primary author's name were, in some instances, needed to identify whether or not studies were nurse-led.

This review also only provides a picture of randomised controlled studies conducted by nurses in the last five years. Quasi-experimental, observational and qualitative studies were not included, nor were secondary analyses such as systematic reviews and meta-analyses. Therefore, this review cannot provide an indication of the non-experimental or synthesised body of evidence generated by nurses in this clinical setting. We also only included studies published in English. Future studies may seek to investigate the body of nurse-led research conducted using these study designs to gain a more inclusive snapshot of research in this clinical setting.

Conclusions

This scoping review has identified clear areas of perioperative care that have been the focus of nurse-led randomised controlled trials. The emphasis has been on supportive care of both patients, and caregivers. Most conducted research has involved multiple phases of care, across the perioperative pathway. Significant issues affecting the quality of experimental nurse-led research conducted in the perioperative setting have also been identified, mainly relating to blinding and randomisation. Acknowledging these issues provides opportunities for maximising research quality in nurse-led experimental research. Gaps in perioperative nursing research exist in focused assessment of intra-operative or procedural aspects of care, patient safety outcomes and care of vulnerable groups. Opportunities also exist for nurses to contribute to multidisciplinary research priority setting in the perioperative field and focus on the translation of evidence to practice in areas such as anxiety prevention where further extensive experimental research may not be warranted. Priority settings must also include patients and caregivers as stakeholders to ensure that we are meeting their needs.

Ethical considerations

This review did not involve primary research and therefore ethical approval was not required. However, a potential conflict of interest relating to one of the primary review authors also being the author of one of the included randomised controlled trials was noted. In this instance, the review author was not involved with the critical appraisal of this study.

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This review is one of a series of scoping reviews currently being conducted by researchers within the acute and critical care research group at Queensland University of Technology (QUT). They aim to identify current nurse-led research activities in acute and critical care settings (including perioperative care) and nursing research priorities. This collaborative group includes a number of university-based researchers and clinician researchers working in acute and critical care settings to ensure that the review outcomes are clearly linked to clinical practice. Within this group, we wish to acknowledge the input of Dr Petra Lawrence for assistance in critical appraisal and data extraction.

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Nurse-led randomised controlled trials in the perioperative setting: A scoping review

Supplement 1: Verification form

Question (Response to each question must be 'yes' for paper to be included.)	**Response**	
Is the paper a randomised controlled trial?	Yes ☐	No ☐
Is the paper nurse-led (is the first or last author a nurse as per listed qualifications)?	Yes ☐	No ☐
Is the article published between January 2014 and May 2019?	Yes ☐	No ☐
Is the topic of the paper related to perioperative care at one or more phases (pre-admission; pre-operatively; intra-operatively; immediately post-operatively)?	Yes ☐	No ☐
Eligible for inclusion?	Yes ☐	No ☐

Supplement 2: Data extraction form

Author/s			
Year of publication		Country of origin	
Primary aim			
Secondary aim/s			
Study population			
Sample size		Study design	
Intervention			
Comparator/s			
Timing of intervention			
Timing of comparator			
Outcome measurements			
Outcome assessor		Outcome points	
Outcome measurements methods			
Findings			
Primary outcome			
Secondary outcome/s			
Reviewer comments			
Funding source			

Supplement 3: Table of included studies

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Al-Azawy, (2015) Norway	To compare and evaluate the effect of premedication, standardised pre-operative information and anxiety on pain intensity, drug consumption and satisfaction.	pain intensity	pre-operative anxiety on pain intensity and drug consumption	adults >18 years	Patients undergoing ablation for AF under conscious sedation	60	I pre-operative information, medication one hour prior to surgery O: baseline, during and after procedure	Supported by Department of Heart Disease Haukeland University Hospital, Bergen. No specific funding mentioned.
Al-Yateem (2016) UAE	To assess play distraction versus premedication.	anxiety (mYPAS)	anxiety (STAIC)	children 3–8 years	ASA I–II undergoing elective day surgery under GA	168	I: one hour prior to surgery O: during anaesthesia, pre-operatively, induction, anaesthatively, upon discharge	Funded by a grant from University of Sharjah.
Ayik (2018) Turkey	To measure effects of lavender oil aromatherapy massage versus usual care.	anxiety (STAI)	sleep quality	adults >18 years	Colorectal surgery	80	I: pre-operatively – night before and morning of surgery) O: pre-operatively – night before and morning of surgery (after massage / usual care)	No specific grant funding received.
Baker (clinical trial protocol) USA	To compare IV versus oral acetaminophen (paracetamol).	pain	1. opioid consumption 2. PONV 3. post-operative respiratory depression 4. administration of reversal agents 5. LOS in PACU 6. Satisfaction	adults >18 years	Multiple surgical specialities	120	I: pre-operatively O: within 24 hours (except patient satisfaction – two days post-operatively)	Not stated.
Bakhshi (2014) Iran	To assess effects of positioning and early sandbag removal.	back pain	1. foot pain 2. haematoma 3. dorsalis pedis pulse 4. bleeding	adults	post-coronary angiography patients	80	I: after catheterisation O: one, two, three and six hours post-operatively and the following morning	No statement of funding evident.
Baradaranfard (2018) Iran	To evaluate impact of warming (forced air versus warmed IV fluids versus control) on physiological indices.	core body temperature	1. blood pressure 2. heart rate 3. shivering	adults 18–65 years	laparoscopic cholecystectomy	96	I: from induction of anaesthesia until PACU discharge O: before induction of anaesthesia until discharge from PACU	Funding by Isfahan University of Medical Sciences.
Brix (2016) Denmark	To compare two anaesthetic techniques.	post-operative pain (NRS)	1. intraoperative fentanyl use 2. analgaesic and antiemetic use in PACU 3. PONV occurrence 4. time to PACU discharge 5. recalled worst pain after discharge 6. recalled PONV after discharge	adult females	ambulatory operative hysteroscopy	153	I: initial surgery O: immediately post-operatively and two weeks post-discharge	Author has received funding from Hede Nielsen Family Foundation, the Gurli and Hans Engell Friis Foundation, the Aase and Ejnar Danielsens Foundation and the Health Research Fund of Denmark.
Çakar (2017) Turkey	To assess pre-operative oral carbohydrate vs standard fasting.	pre-operative discomfort –hunger, thirst, mouth dryness, chill, headache	1. post-operative complications 2. physiological parameters 3. PONV 4. pain	adults 16–80 years	thyroidectomy	95	I: from 00.00 hours night before surgery O: 10 pm and 6 am prior to surgery, every two hours post-surgery	No statement of funding.
Carlsson (2018) Sweden	To assess the effectiveness of pre-operative visits to the operating theatre on anxiety.	anxiety (mYPAS)	parental anxiety (STAI)	children 3–12 years and their parents	ENT day surgery	57	I: prior to the day of surgery O (children): in the waiting room, after arrival to OR, at anaesthesia induction O (parents): in waiting room and once child anaesthetised	Centre of clinical research in Värmland supported the project.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Carr (2015) USA	To compare P6 stimulation versus control on PONV	PONV (Likert nausea scale score)	Nil	adult females 18–67 years	laparoscopic cholecystectomy	56	I: intraoperatively O: on admission to PACU; at 30 and 60 mins, PACU discharge, at home up to 24 hours	No statement of funding.
Charette (2015) Canada	To assess guided imagery and relaxation combined with education versus usual care.	pain intensity	1. anxiety (STAI-Y) 2. coping strategies 3. regular activities	adolescents and young adults	spinal fusion for scoliosis	40	I: commenced pre-operatively O: day of surgery to two weeks post-discharge	Funded by the Canadian Nurses Foundation; the Quebec Inter-university Nursing Intervention Research Group (GRIISIQ); the Quebec Ministry of Education, Recreation and Sports; the Fonds de Recherche du Quèbec-Santè (FRQS); The Saite Justine Hospital Foundation; the Foundation of Stars and the Gustav Levinschi Foundation.
Chartrand (2017) Canada	To examine the effect of a pre-operative DVD on parental knowledge versus standard care.	parental knowledge	1. participation 2. anxiety 3. children's distress 4. analgaesia 5. length of recovery	parent–child dyads (children 3–10 years)	elective ENT outpatient or dental surgery	105	I: after pre-assessment clinic appointment O: in the recovery room until discharge from day surgery.	Study funded by Children's Hospital of Eastern Ontario Research Institute Surgery Associates Research and Development Fund. First author also received scholarships.
Chen (2014) USA	To compare carbon dioxide versus room air insufflation.	discomfort	abdominal girth	adults >18 years	screening colonoscopy	98	I: during colonoscopy O: upon arrival to recovery room, at time of post-anaesthesia recovery (PAR) score of 10 or pre-procedure baseline, when eligible for discharge	No funding received.
Chen (2015) Taiwan	To assess effects of music versus no music on psychophysiolog-ical responses	Psycho-physiological parameters (HR, RR, SBP, DBP)	1. pain (VAS) 2. opioid dosage	adults	elective total knee replacement	30	I: pre-operatively; in OR and in PACU O: pre-operatively, in surgical waiting area, in PACU and in post-operative ward	No funding statement.
Chevillon (2015) USA	To evaluate impact of multifaceted pre-operative education versus standard care	post-operative delirium	1. anxiety (STAI) 2. knowledge 3. predictors of delirium 4. days of mechanical ventilation 5. ICU stay (days)	adults	pulmonary thromboendarer-ectomy	129	I: one day prior to surgery O: intra-operatively (cardiopulmonary indicators), daily for up to seven days after surgery or until ICU discharge	No funding statement.
Choi (2018) South Korea	To compare durations of bed rest and immobilisation (three groups).	incidence of post-dural puncture headache (PDPH)	backache	adults >18 years	elective orthopaedic knee or hip, or bladder surgery, or haemorrhoidec-tomy under spinal anaesthesia	138	I: post-surgery O: immediate post-ward transfer then daily for five days	No funding statement.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Conway (2017) Australia	To assess effectiveness of forced air warming versus usual care (passive warming) for hypothermia prevention.	post-procedure temperature	1. shivering 2. thermal comfort 3. major post-operative complications 4. cardiovascular complications, cardioversion or myocardial infarction	adults >18 years	interventional cardiovascular procedures <30 minutes duration with sedation	140	I: during procedure O: during procedure, post-operatively, at 30 days (complications)	First author awarded an NHMRC Early Career Fellowship. Study funded by St Vincent's Clinic Foundation Multidisciplinary Patient Focussed Research Grant. Equipment provided by Covidien Investigator sponsored Research Program.
Dehghan (2017) Iran	To compare dramatic puppet versus therapeutic play versus usual care.	anxiety	nil	children 6–12 years	appendectomy	75	I: pre-operatively, morning of surgery O: night before surgery, pre-operatively before anaesthesia	Supported by Mashhad University of Medical Sciences.
Deitrick (2015) USA	To compare two doses of IV promethazine (6.25mg versus 12.5mg).	PONV (verbal descriptive scale)	post-operative sedation (institution's internal sedation scale)	adults 18–75 years	ambulatory surgery	120	I: throughout Phase I and Phase II recovery O: throughout Phase I and Phase II recovery	Combined AORN/STTI International Small Grant.
Dickinson (2015) USA	To assess silver impregnated dressings versus dry sterile dressings.	wound healing	infection	Adults	cardiac surgery with sternotomy wound	315	I: incision closure O: five days post-operatively and throughout recovery	No funding statement but dressings donated by manufacturers.
Duparc-Alegria (2018) France	To assess impact of short hypnotic session versus usual care.	post-operative pain (VAS)	1. anxiety level 2. total morphine consumption	children 10–18 years	routine major orthopaedic surgery	119	I: just prior to surgery O: 24 hours post-operatively	Funded by Ministry of Health grant and sponsored by Assistance-Publique-Hôpitaux de Paris-Direction Recherce Clinique et du Développement.
Erdling (2015) Sweden	To compare oesophageal and nasopharyngeal temperature in patients receiving prewarming versus no prewarming.	difference in temperature change between devices and warming groups	effect of prewarming, age and Body Mass Index (BMI) upon measured temperatures (two devices)	adults	elective open colorectal surgery under combined anaesthesia	53	I: pre-operatively (prewarming) or intra-operatively O: before epidural, after test dose, anaesthesia start and then at 30 minute intervals	No funding statement.
Ertug (2017) Turkey	To compare nature sounds versus relaxation exercises versus no intervention.	anxiety	nil	adults >18 years	elective surgery (under GA)	159	I: day of surgery O: day of surgery, recruitment, after intervention, 30 minutes post-intervention	No funding statement.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Fetzer (2018) USA	To assess effectiveness of pre-emptive pre-operative belladonna and opium suppository versus routine care.	post-operative bladder comfort (bladder urgency via five-point Likert scale and pain via 0–10 VAS)	1. narcotic requirements 2. LOS	adults	ureteroscopy	50	I: after anaesthesia induction and before insertion of surgical scope O: during PACU at every 15 minutes until discharge, outpatient discharge	One author funded by Vermont/ New Hampshire Association of Perianaesthesia Nurses for cost of study medication.
Franzoi (2016) Brazil	To compare listening to music versus usual care (toys and television).	anxiety	1. HR 2. SBP 3. DBP 4. RR 5. oxygen saturation	children 3–12 years	elective surgery under GA	52	I: day of surgery O: 15 minutes post-intervention	No funding statement.
Fuganti (2018) Brazil	To evaluate effect of prewarming versus usual care (cotton blankets) on body temperature.	tympanic temperature	1. air temperature in OR 2. humidity OR	adults >18 years	elective gynaecological surgery	86	I: pre-operatively O: after prewarming and at 30 minute intervals until end of surgery	No funding statement.
Garcia (2018) Brazil	To compare therapeutic listening versus standard care.	anxiety	1. surgical fears 2. salivary cortisol 3. HR 4. RR 5. SBP 6. DBP	adults >18 years	surgery for colorectal cancer	50	I: day of surgery O: pre-intervention at 2.5 hours, then 1 hour post-procedure	Supported by Conselho Nacional de Desenvolimento Cientifico e Tecnológico (CNPa), Brazil, grant.
Gomez-Urquiza (2016) Spain	To compare projection of photos versus photos and music versus usual care	anxiety	1. HR 2. RR 3. DBP 4. SBP	adults 25–50 years	ENT surgery	180	I: day of surgery O: pre-operatively from 45 to 120 minutes prior to surgery	No funding received.
Gross (2016) USA	To assess outcomes after three different dressing practices.	air leak	1. patient comfort 2. skin integrity at incision site	adults >18 years	patients with chest drains	64	I: following insertion of chest tube in OR O: upon post-operative arrival to trauma centre and then daily up until a maximum of five days	No funding statement.
Groton (2015) USA	To evaluate effectiveness, tolerability and cost of three bowel preparations (three groups).	effectiveness of bowel preparation	1. tolerability 2. cost	adults >18 years	outpatient colonoscopy	276	I: prior to colonoscopy O: during colonoscopy, post-procedure and at follow-up clinic	No funding received.
Ham (2017) South Korea	To assess saline solution replacement versus not changing saline solution.	colony forming units (CFU)	nil	adults >18 years	colectomy for colon cancer	52	I: intra-operatively after colon removal (intervention) O: 48 hours post collection	Funded by Konkuk University GLOCAL Campus, Republic of Korea.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Handan (2018) Turkey	To assess impact of music during caesarean delivery versus usual care.	Anxiety (VAS)	1. body temperature 2. oxygen saturation 3. RR 4. HR 5. SBP 6. DBP	females	caesarean delivery for multiple births	60	I: during surgery O: at the end of surgery	Supported by the Scientific Research Project Fund of Karamanoglu Mehmetbey University.
He (2015) Singapore	To assess therapeutic care versus standard care (plus information pamphlet).	anxiety	1. negative emotional manifestation 2. post-operative pain	children 6–14 years	inpatient elective surgery	95	I: three to seven days prior to surgery O: baseline, day of surgery, 24 hours post-surgery	Funded by the National Medical Research Council New Investigator Grant, Ministry of Health, Singapore.
Hoffman (2017) USA	To assess efficacy of P6 acupressure versus placebo	PONV incidence	N/A	adults	planned ambulatory surgery; high risk for PONV	110	I: pre-operatively: 30-60 minutes pre-induction O: three recovery phases – Phase 1 (PACU), Phase 2 (pre-discharge), Phase 3 (24 hours post-discharge)	No funding statement.
Kapritsou (2018) Greece	To compare fast-track conventional recovery protocols.	LOS	1. readmission rates 2. complications 3. pain (VAS)	adults 30–82 years	hepatectomy	62	I: immediately after surgery O: point of discharge	No funding received.
Karunagaran (2016) India	To assess video-assisted learning versus usual care.	knowledge	1. anxiety (STAI) 2. physiological and behavioural responses 3. relationship between knowledge, anxiety and physiological responses	adults	gastroscopy	72	I: pre-procedure O: 30 minutes prior to procedure	College of Nursing, Christian Medical College, Vellore, Tamil Nadu.
Kelly (2017) USA	To assess effectiveness of folded and rolled dry cotton blankets warmed in 130°F or 200°F cabinets.	skin temperature	1. thermal comfort 2. safety	adults >18 years	hospital volunteers or employees (healthy volunteers)	20	I: in-vitro (in perioperative setting) O: at regular intervals up to 40 minutes after blanket application	No funding statement.
Klintworth (clinical trial protocol) USA	To examine the use of 2% chlorhexidine gluconate cloths pre-operatively and daily post-operatively versus standard care.	surgical site infection	1. serious adverse events 2. mortality	adults >18 years	colorectal surgery	163	I: pre- and post-operatively up to four days O: up to 30 days post-operatively	No funding statement.
Koenen (2017) Australia	To compare reflective blankets versus cotton blankets for reduction of core-periphery heat gradient.	pre-operative change in foot temperature	1. normothermia on arrival to PACU 2. proportion of patients requesting additional warmed blankets	adults	elective surgery more than one hour duration	328	I: pre-operative holding bay O: on admission and then at regular intervals until before discharge from PACU	Supported by the NSW Health Education and Training Institute (Rural Research Capacity Building Program).

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Kose (2016) Turkey	To assess different hair shaving practices.	surgical site infection	body image	adults	elective cranial surgery	200	I: pre-operatively in OR O: Post-operatively – first, third, fourth, seventh and tenth days	Funded by Gulhane Military Medical Academy Scientific Research Council.
Kurtovic (2017) Croatia	To compare post-operative analgaesic efficacy of intermittent versus PCA paracetamol.	Post-operative analgaesic efficacy	nil	adults 27–80 years	elective lumbar discectomy of intervertebral disc extrusion at L4-L5	56	I: in OR on completion of surgery to 48 hours post-operatively every six hours O: In OR on completion of surgery to 48 hours post-operatively	No funding statement.
Lee (2015) Taiwan	To compare post-operative heat-preserving gown versus cotton cloths to reduce duration of hypothermia.	hypothermia duration	1. cost effectiveness 2. thermal comfort	adults	post-spinal surgery (in PACU)	100	I: PACU O: post-operatively: on admission to PACU until normothermia achieved	No funding statement.
Lee (2018) Taiwan	To assess nurse-delivered education with video versus standard care	anxiety (STAI and cortisol levels)	pain	adults ≤ 20 years	lumbar spinal surgery	86	I: day before surgery O: day before surgery; 30 minutes pre-surgery, day after surgery	No funding statement.
Li (2014) Hong Kong	To assess therapeutic play with dolls versus standard care (pre-operative preparation).	anxiety (STAIC)	1. parental anxiety 2. satisfaction (child and parental)	children 7–12 years	elective surgery	108	I: day of surgery O: before and after intervention, post procedure	Supported by the Health and Health Services Research Fund, Food and Health Bureau, Hong Kong SAR Government.
Liguori (2016) Italy	To examine Clickamico app with clown doctors versus standard care (brochure).	pre-operative anxiety (mYPAS)	nil	children 7–12 years	elective surgery	40	I: night prior to procedure O: afternoon before surgery, day of surgery (on transfer)	Funded by the Department of Health Sciences at the University of Florence, the Meyer Children's Hospital, and the Meyer Foundation.
LoRusso (2018) USA	To evaluate blood glucose levels of Type II diabetic patients with use of etomidate versus propofol for induction of anaesthesia.	perioperative blood glucose	nil	adults	patients with Type II diabetes undergoing surgery	18	I: at induction O: at induction and following emergence from anaesthesia	No funding statement.
Lynch (2015) USA	To compare room air versus carbon dioxide insufflation	pain intra-procedure and anaesthative-ly (non-verbal and verbal pain scale)	1. length of recovery 2. nursing tasks and time	adults	routine screening or surveillance colonoscopy under moderate sedation	191	I: during procedure O: during and post-procedure	No funding received..
Ma (2015) China	To assess three perineal disinfection solutions.	pre-operative bacterial count	nil	adults or children	urethral opening surgery		I: five times a day O: one and two days post-procedure	No funding statement.
Martin (2014) USA	To examine the impact of therapeutic suggestion under anaesthesia.	LOS	1. anxiety (VAS and CRA scale) 2. pain (FLACC and Wong–Baker FACES pain rating scale) 3. intravenous morphine dosage 4. PONV 5. emergence delirium 6. implicit memory	children 4–8 years and self-identified primary caregiver	non-coblation tonsillectomy or adenotonsillectomy	94 child–care-giver pairs	I: completion of surgery until readiness to wake up in PACU O: post-operatively (PACU)	Funded by ASPAN grant, and an XTO Energy Clinical Scholars Grant.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
McClurkin (2016) USA	To assess impact of self-selected music versus music versus no music (usual care).	anxiety (STAI)	1. patient satisfaction 2. relationship between STAI and NVAAS	adults 18–75 years	day surgery (multiple specialities)	133	I: pre-operatively O: afternoon prior to surgery, day of surgery (on transfer)	Funded by Baylor St. Luke's Nursing Research Council and the Friends of Nursing.
Mirbagher (2016) Iran	To assess effects of mentoring versus usual learning activities.	clinical perioperative competence	nil	adults	OR students	60	I: over 15 months O: before and after intervention	No funding statement.
Molloy (2016) USA	To compare preventative use of dorzolamide-timolol ophthalmic solution with balanced salt solution.	intraocular pressure	time effects	adults	patients scheduled for prolonged steep Trendelenburg procedures	90	I: following induction of anaesthesia O: baseline, then every 30 minutes during surgery	No funding statement.
Mousavi (2018) Iran	To assess supportive educational nurse-led interventions versus standard care	anxiety (STAI)	sleep (GSQS)	adults	Elective coronary artery bypass graft (CABG) surgery	160	I: one and two days prior to surgery O: day of admission, night before surgery	Funded by Tehran University of Medical Sciences.
Munday (2018) Australia	To compare pre-operative warming plus IV fluid warming versus usual care including IV fluid warming.	perioperative heat loss	1. hypothermia 2. maternal thermal comfort 3. MAP 4. shivering 5. agreement between temperature devices 6. neonatal temperature 7. Apgar score	women >18 years	women undergoing elective Caesarean delivery with intrathecal morphine	50	I: pre-operatively O: post-operatively up to discharge	Funding by Perioperative Nurses Association of Queensland (PNAQ).
Nieh (2018) Tawain	To assess efficacy of forced air warming versus passive insulation on rewarming.	rewarming	thermal comfort	adults >20 years	laparoscopic thoracic or abdominal surgery over one hour anaesthesia	127	I: during anaesthesia until PACU discharge O: every 30 minutes intra-operatively and in PACU until normothermia achieved	Taichung Veterans General Hospital, Republic of China.
Nilsson (2014) Sweden	To assess effectiveness of P6 acupressure (with Sea-Band) versus placebo on post-operative nausea.	post-operative nausea	frequency of vomiting	adults >18 years	elective infratentorial or supratentorial craniotomy	120	I: applied at the end of surgery O: on arrival to PACU; then at specified intervals until 48 hours post-operatively	Devices partly provided by SeaBand Ltd, remainder provided by Department of Neurosurgery of Umeå University Hospital. Study supported by hospital's research foundation.
Notte (2016) USA	To measure effect of Reiki versus usual care on perceived pain.	perceived pain	1. post-operative analgaesic consumption 2. satisfaction with Reiki 3. satisfaction with hospital experience	adults 18–30 years	total knee arthroplasty (TKA)	43	I: after admission, after admission to PACU, daily for three post-operative days O: before and after each treatment or at each participant–nurse encounter	Funded by Sharpe/Strumia Research Foundation of Bryn Mawr Hospital.
Oh (2017) Korea	To compare effects of transcutaneous electrical nerve stimulation relief band with wrist band with acupressure on Nei-Guan acupuncture point.	PONV (Rhodes Index of Nausea, Vomiting and Retching)	frequency of patient-requested anti-emetics	adult females 16–65 years	gynaecology surgery under general anaesthesia with PCA	54	I: prior to anaesthesia O: at 0–24hours after PACU discharge	No funding received.
Oliveira (2016) Brazil	To assess pre-operative orientation video versus usual care.	patient knowledge	nil	adults >18 years	cardiac surgery	90	I: approximately 72 hours prior to surgery O: Post-intervention	Funded by Fundo de Apio à Pesquisa do Instituo de Cardiologia (FAPIC).
Ozlu (2018) Turkey	To assess the effect of cold application versus no cold application on pain and bleeding	pain	bleeding	adults >18 years	septoplasty to correct deviated septum	60	I: in ENT clinic for 15 minutes prior to surgery O: post-operatively at regular intervals up to 24 hours	No funding received.
Palese (2015) Italy	To assess post-operative shampooing versus no shampooing.	comfort	1. surgical site contamination (CFU) 2. surgical site infection	adults >18 years	elective craniotomy	53	I: post-procedure O: 30 days post-surgery	No funding statement.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Paris (2014) USA	To examine effect of various warming methods on maternal body temperature during Caesarean delivery.	maternal core body temperature	1. maternal hypothermia 2. estimated blood loss 3. post-operative pain 4. rescue blanket use 5. maternal shivering 6. maternal–newborn bonding 7. first axillary newborn temperature 8. cord pH 9. Apgar scores (one and five minutes)	women	elective, singleton Caesarean delivery	226	I: pre-operatively until two hours post-delivery O: pre-operatively through to fourth postpartum hour.	Medline Industries donated the warming pad and temperature sensing Foley catheters.
Piredda (2016) Italy	To evaluate effectiveness of information booklet alone or with clarification questions versus standard care (three groups).	short- and long-term knowledge regarding totally implantable access ports (TIAPs)	physiological indicators of anxiety	adults >18 years	patients diagnosed with cancer, admitted to day surgery for insertion of TIAP	105	I: In day surgery waiting room O: before TIAP implantation, in waiting room, at three months	Funded by Center of Excellence of Nursing Research and Culture, Nursing Professional Board of Rome.
Pool (2015) USA	To assess raising head of bed to 15 degrees versus keeping flat.	patient comfort: pain (VAS)	nil	adults	cardiac angiography	71	I: post-procedure O: before procedure, every 15 minutes post-procedure	No funding statement.
Pu (2014) China	To assess feasibility and efficacy of intra-operative underbody warming vs passive warming.	intra-operative hypothermia	1. temperature decline (via nasopharyngeal temperature) 2. prothrombin time 3. activated partial thromboplastin time 4. thrombin time 5. complications: in OR and post-operatively 6. shivering 7. pain (VAS)	adults >18 years	open and laparoscopic surgery for gastrointestinal tumours	110	I: intra-operatively O (primary): from anaesthesia induction, every 20 minutes until end of procedure O (secondary): in OR, end of anaesthesia, post-operative day 1	Funded by the Science and Technology Commission of Shanghai Jiao Tong University.
Qvarfordh (2014) Denmark	To assess mobilisation shortly after lumbar disc surgery versus wheeling from PACU to ward.	feasibility	1. safety 2. wellbeing (Bournemouth questionnaire)	adults >18 years	elective lumbar discectomy	22	I: one hour post-operatively O: one hour post-operatively	Funded by Glostrup Hospital, the Capital Region of Denmark.
Reynolds (2015) Australia	To assess BPU, SSD and TA versus usual care.	feasibility	1. peripheral arterial catheter failure 2. dislodgement 3. occlusion 4. phlebitis 5. infection: local or CRBSI	adults >18 years	surgical patients booked for post-operative ICU	123	I: operating theatre O: on insertion of arterial catheter in OR, daily in ICU, on ICU discharge	Funding provided for products by the Alliance for Vascular Access Teaching and Research Group (AVATAR) at Griffith University.
Razera (2016) Brazil	To assess use of educational video versus usual care.	knowledge of informal caregivers	nil	Unclear: caregivers of children	informal caregivers of children undergoing primary cheiloplasty and/or palatoplasty	80	I: post-operatively, on day of discharge (24 hours post-surgery) O: peri- and post-operatively on discharge	PhD scholarship funding by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).
Rhodes (2015) USA	To assess effect of pre-operative education and orientation versus no education and orientation.	anxiety	1. caregiver anxiety 2. LOS 3. morphine equivalent use 4. patient/caregiver satisfaction	children 11–21 years	posterior spinal fusion (PSF) surgery	65	I: pre-operative O: two weeks pre-operatively, immediately prior to surgery, during surgery, post-operative day 2, on discharge	No funding statement.
Sáenz-Jalón (2017) Spain	To assess the limb occlusion pressure technique versus standard pneumatic ischemia technique.	arterial blood pressure	1. ischemia time 2. anaesthetic incidents: pain, administration of opiates 3. surgical incidents: interruptions to procedure, bleeding 4. LOS	adults	upper limb surgery requiring surgical ischemia and locoregional anaesthesia	160	I: intra-operative O: intra-operatively and post-operatively (LOS)	Funded by Premio Nacional de Investigación de Enfermería Valdecill a del año 2012.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Sahin (2018) Turkey	To evaluate acupressure versus placebo application on P6 acupoint.	PONV	1. post-operative pain severity 2. analgaesic drug requirement 3. anxiety 4. patient feedback	adults (females)	laparoscopic cholecystectomy		I: one hour prior to surgery O: At two, six and 24 hours post-operatively	No funding received.
Salomon (2018) USA	To assess pre-operative telephone communication by nurse anaesthetist versus standard care (face-to-face on morning of surgery).	anxiety (APAIS, STAI Y-1)	nil	adults	office-based anaesthesia for urological procedures	41	I: pre-operative – night before surgery (intervention), day of surgery (control) O: pre- and post-operatively	No funding statement.
Simeone (2017) Italy	To evaluate the efficacy of a nursing educational intervention.	parental anxiety (STAI)	nil	adults	parents of children undergoing cardiac surgery for interventricular defect for the first time	96	I: pre-operatively O: unclear (stated pre- and post-operatively	No funding statement.
Sites (2014) USA	To evaluate controlled breathing with peppermint aromatherapy versus controlled breathing alone for PONV relief.	PONV	administration of post-operative anti-emetics	adults >18 years	elective laparoscopic, ENT, orthopaedic or urological day surgery under GA with intubation	330	I: upon initial report of PONV in PACU or day surgery O: post-operatively in PACU or day surgery	No funding statement.
Stallings-Welden (2018) USA	To examine effectiveness of aromatherapy with standard care for PONV.	PONV	1. post discharge nausea and vomiting (PDNV) 2. risk factors for PONV	adults >18 years	ambulatory surgical patients	221	I: post-operatively and through discharge O: post-operatively and after discharge	No funding statement.
Stewart (2018) USA	To compare tablet-based interactive distraction with oral midazolam.	pre-operative anxiety (m YPAS-SF)	1. emergence delirium 2. PACU LOS 3. caregiver anxiety (seven-point Likert) 4. caregiver satisfaction (seven-point Likert)	children 4–12 years and caregivers	outpatient surgery	102 patients (and 102 care-givers)	I: pre-induction O: on admission, parental separation, mask induction and then on emergence	Funded by West Coast University.
Su (2018) Taiwan	To assess efficacy of forced air warming versus passive insulation.	perioperative hypothermia	1. shivering 2. pain 3. blood loss 4. adverse cardiac events	adults >20 years	laparoscopic thoracic or abdominal surgery	124	I: during anaesthesia, intra-operatively until end of PACU O: every 30 minutes intra-operatively and in PACU until normothermia achieved	Taichung Veterans General Hospital, Republic of China.
Tsai (2017) Taiwan	To assess effectiveness of three antiseptic handwashing methods amongst surgical staff.	CFU counts	time for hand cleansing	adults	practicing surgeons and scrub nurses with experience of conventional surgical and waterless hand rub OR protocols		I: immediately pre-operatively O: before and after surgical hand disinfection, immediately after operation	Funded by Taipei Medical University, Shuang Ho Hospital.
Ugras (2018) Turkey	To assess different types of music versus no music (three groups).	pre-operative anxiety (STAI)	1. SBP 2. DBP 3. HR 4. cortisol levels	adults	surgical otorhinolaryn-gology patients	180	I: music for 30 minutes pre-procedure O: at completion of intervention	No funding received.
Ullan (2014) Spain	To assess effect of play versus usual care	post-surgical pain (FLACC)	nil	children 1–7 years	elective surgery	95	I: during hospital stay O: each hour post-operatively, commencing when consciousness regained	Funded by The Council of Education of the Junta of Castilla and Leon Spain, and the Spanish Ministry of Education.
Unulu (2018) Turkey	To assess effectiveness of P6 acupuncture.	nausea intensity	1. patient information 2. anxiety 3. perianesthesia comfort 4. general comfort	adults	gynaecologic (not obstetric) surgery		I: within 12 hours after procedure O: post-operatively (0–2, 2–6, 6–12, 12–24 and 24–48 hours	No funding statement.

First author (year), country	Primary aim	Primary outcome	Secondary outcome/s	Participant age	Surgical population	Total sample size (n)	Timing of intervention (I) and timing of outcome (O)	Funding
Webster (2014) Australia	To assess consumption of carbohydrate fluids versus usual care	Time to readiness to discharge	1. time to first flatus 2. time to first bowel movement 3. mortality (from any cause during trial) 4. adverse outcomes	adults >18 years	elective bowel surgery	46	I: from 19.00 the night prior to surgery O: post-operatively	No funding statement.
Wilson (2016) Canada	To assess individualised education prevention.	nausea	1. pain 2. analgaesic and anti-emetic administration	adults	total knee replacement surgery		I: pre-operatively O: post-operatively day 3	Partially funded by the Kingston General Hospital Women's Auxiliary Millennium Fund.
Wistrand (2016) Sweden	To compare preheated and room temperature skin disinfectant solution.	skin temperature	patients' experience	adults >18 years	patients undergoing pacemaker, implantable cardioverter-defibrillator or cardiac resynchronisation therapy under local anaesthesia	220	I: OR (immediately prior to procedure) O: Before and after skin disinfection (in OR)	Funded by research council of Örebro County Council.
Wu (2019) China	To assess safety and feasibility of early oral hydration in the PACU.	PONV	1. thirst 2. incidence of oropharyngeal discomfort 3. patient satisfaction	adults	elective laparoscopic cholecystectomy	1735	I: post-operatively (PACU) O: post-operatively up to day 1	Funded by the Sichuan Provincial Health Department.
Zaman (2018) Iran	To assess effect of warm versus room temperature IV fluids.	shivering	1. core temperature 2. oxygen saturation 3. vital signs	adults	elective abdominal surgery	70	I: intra-operatively O: post-operatively – on admission to PACU and at 30 minutes in PACU	No funding statement.

Abbreviations: AF = atrial fibrillation; APAIS = Amsterdam Preoperative Anxiety and Information Scale; AORN = Association of periOperative Registered Nurses; ASA I–II = American Society of Anesthesiologists classification normal healthy patients to patients with mild systemic disease; ASPAN = American Society of PeriAnesthesia Nurses; BPU = Bordered Polyurethrane; CFU = colony forming unit; CRA scale = Child Rating of Anxiety scale; CRBSI = Catheter-related bloodstream infection; DBP = diastolic blood pressure; ENT = ear, nose and throat; FLACC = Faces, Legs, Activity, Cry, Consolability scale; GA = general anaesthetic; GSQS = Groningen's Sleep Quality Scale; HR = heart rate; ICU = intensive care unit; IV = intravenous; LOS = length of stay; MAP = mean arterial pressure; mYPAS = modified Yale Preoperative Anxiety Scale; mYPAS-SF = modified Yale Preoperative Anxiety Scale Short Form; NHMRC = National Health and Medical Research Council; NRS = numeric rating scale; NVAAS = Numerical Visual Analog Anxiety Scale; OR = operating room; P6 = pericardium acupuncture point; PACU = Post Anaesthesia Care Unit; PCA = patient-controlled analgesia; PONV = post-operative nausea and vomiting; RR = respiratory rate; SBP = systolic blood pressure; SSD = sutureless securement device; STAI = State-Trait Anxiety Inventory; STAIC = State–Trait Anxiety Inventory for Children; STAI-Y = State–Trait Anxiety Inventory (Form Y); STTI = Sigma Theta Tau International; TA = tissue adhesive; UAE = United Arab Emirates; USA = United States of America; VAS = Visual Analog Scale