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The effect of pre-anaesthetic assessment clinic: a systematic review of randomised and non-randomised prospective controlled studies

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ABSTRACT

Objectives: The aim of this systematic review was to examine the effectiveness of pre-anaesthetic assessment clinics (PACs) implemented to improve quality and patient safety in perioperative care.

Design: Systematic review.

Data sources: The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) were systematically searched from 1st April, 1996 to 4th February, 2021.

Eligibility criteria: The main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs.

Data extraction and synthesis: Titles, abstracts, and full texts were screened in duplicate by two authors. Risk of bias assessment, using the Joanna Briggs Institute critical appraisal checklist for quasi-experimental studies, and data extraction were performed by one author and checked by the other author. Results were synthesised narratively owing to the heterogeneity of the included studies.

Results: Seven prospective controlled studies were conducted. Most studies had a high risk of bias. Three studies reported a significant reduction in the length of the hospital stay, and two studies reported a significant reduction in cancellation of surgery for medical reasons when patients were seen in the PAC. In addition, the included studies presented mixed results regarding anxiety in patients.

Conclusion: This systematic review demonstrated a reduction in the length of hospital stay and cancellation of surgery when the patients had been assessed in the PAC. There is a need for high-quality prospective studies to gain a deeper understanding of the effectiveness of PACs.

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Keywords: pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic review

ARTICLE SUMMARY

Strengths and Limitations of this study

- Only prospective studies were included in this systematic review.
- The systematic review was conducted in accordance with international guidelines.
- Only seven studies were identified, highlighting the need for further research on pre-anaesthetic assessment clinics.
- Overall, the quality of the included studies was low, and the current practice possesses limited evidence base.

INTRODUCTION

Anaesthesia constitutes an important part of surgery; however, it has the potential to activate physiological changes that can increase morbidity and mortality,[1] mainly depending on the patients' preoperative health condition and age.[2] Hospitals are treating patients with complex, comorbid healthcare problems who undergo progressively extensive surgeries and interventions.[3,4] To ensure the quality and safety of anaesthesia and surgery, precise knowledge of the clinical characteristics of patients undergoing surgery is critical to the perioperative treatment plan.[2] Over the past 50 years, perioperative mortality, including anaesthesia-related mortality, has declined, with the most significant decline observed in developed countries,[1,5] mainly due to new anaesthetics, improved monitoring equipment and training, availability of recovery rooms, and improved airway management.[4] However, an Australian study reported that 14% of anaesthetic-surgical complications and 39% of deaths attributed to anaesthesia were associated with insufficient and/or inadequate preoperative evaluation.[6] A Danish retrospective investigation showed that the deaths among patients undergoing surgery could have been prevented by a thorough preoperative evaluation,[7] indicating that risk factors are both patient-and

surgery-related and linked to organisational structures.[8] Future efforts should improve preoperative anaesthesia safety,[9] by improving planning and preparation for elective procedures and interventions.

In 1949, Lee discussed the value of the "anaesthetic outpatient clinic" in the preparation of patients for surgery.[10] Today, an increasing number of pre-anaesthesia assessment clinics (PACs) are supporting hospitals in handling the rise in the number and complexity of surgical procedures.[11] The PAC consultation, conducted by the anaesthesiologist, anaesthesia nurse, or both, is globally recognised as an evaluation method while optimising the patients' medical condition prior to surgery and anaesthesia, and is considered essential in securing anaesthetic practice since it detects anaesthesia-related risk factors and high-risk patients, improves patient outcomes, prepares the patient physically and psychologically for anaesthesia, and ensures the patient's most favourable condition for surgery and anaesthesia.[12-14] Considering the well-prepared patients and staff, several researchers posit that with PAC, the number of surgical cancellations, length of hospital stay, and mortality rate are reduced, and tests are minimised.[8,15,16] Others assert that patients feel less anxious regarding the subsequent anaesthetic and surgical processes and are highly satisfied with this service when PACs are used.[15,17,18]

As Turunen *et al.* state, research on PACs is scarce regarding costs, financial savings, the impact on patient safety and quality of care, accuracy of operative patients, and effect on preoperative nursing levels.[19] Survey results indicate that anaesthesiologists perceive day of surgery delays due to missing information as common, even with PAC consultations.[20] The present systematic review examines the outcomes of PAC as systematic work on quality

and patient safety, including identifying the areas for improvement, implementing interventions, and ensuring that patient outcome improvement.

METHODS

The aim of this systematic review was to examine the effectiveness of PACs in improving quality and patient safety in preoperative care. A further aim was to determine the gaps in existing knowledge for future research. Our systematic review followed the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions [21] and was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[22] The protocol was published in PROSPERO: CRD42019137724.[23] We had two review questions:

1. What are the effects of PACs on patient satisfaction, anxiety, and safety?
2. What are the effects of PACs on cancellation rate, cost, and efficiency?

Search strategies

We performed a scoping search in different databases to identify the key terms for the literature search.[24,25] The final search was planned and conducted in close collaboration with a university librarian. On 11th September, 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP), and updated it on 4th February, 2021. Considering the lack of subject headings (e.g., MeSH) for PAC, we used text words such as preanaesthesia. The search in Medline is presented in Appendix 1. The search mode in CINAHL was Boolean/Phase, which supports Boolean searching or exact phrase searching. To ensure comprehensiveness, we used both the truncation and proximity operators. We limited the search to 1996 since this was the year one of the first known articles in this area

was published.[23] Complementary methods to identify studies included following up on citations via Scopus, scanning the reference lists of relevant papers and included articles, and checking for relevant studies in clinical trials.[24]

Eligibility criteria

Considering the aim of the review, the main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs. Specific study eligibility criteria were: (a) published in English or Scandinavian language, (b) scientific publication of original research, (c) reporting the outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-randomised prospective controlled studies, and (f) newly established PAC. We excluded: (a) editorials, discussion papers, and conference abstracts, (b) reviews, (c) instrument testing, (d) studies with children, and (e) retrospective studies.

Study selection

All references identified in the search were transferred to EndNoteX9, where the duplicates were removed. Next, all unique references were transferred to the Covidence screening tool.[26] Study eligibility was ascertained independently by two authors, first at the title and abstract level, and subsequently at the full text. Inclusion was determined by consensus, and disagreements were resolved by consulting a third author.

Quality assessment

We used design-specific checklists to assess the studies' risk of bias. Given the methodological similarity of the included studies, only the Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.[27] One author performed the risk of bias assessment, and the other checked the accuracy of the assessment.

Disagreements were resolved through discussion with a third author. Each of the nine checklist questions was answered no, yes, unclear (or not applicable).

Data extraction and analysis

One author extracted data from each included study onto a pre-designed Excel spreadsheet, and another checked the extracted data for accuracy, consistency, and completeness. Extracted information included publication details, study design, setting, and characteristics of the patients, interventions, comparisons, and outcome (PICO). We requested information on the missing data; however, received no response from the author. If the PICO elements were sufficiently similar and statistical data were available, we had planned to conduct meta-analyses. However, the extracted data revealed substantial heterogeneity among the studies, and there were no randomised controlled trials (RCTs). Therefore, we performed a narrative synthesis, describing and comparing the main findings from the included studies, and discussing their methodological strengths and weaknesses.

RESULTS

Figure 1. provides details of the study selection process. A total of 2250 records were identified in the first search and 742 in the second search. After removing duplicates, we screened 2372 records based on the title and abstract; of these, 179 records passed the full-text screening. We included seven studies that met the inclusion criteria.

Overall characteristics of the studies

The seven included studies are listed in Table 1. They were all in English and published in 2000–2017, with data collected in the years 1997–2015 (one did not provide this data collection information).[28] Based on our inclusion criteria, all were prospective controlled studies, but we found no RCTs. There was one controlled before-after study.[34] The other six studies had control groups but no baseline assessments, only assessments following PAC

implementation. There were three 2-group non-parallel after-only studies,[29,30,32] and three 2-group parallel after-only studies [28], where one had a matched control group[31] and one had three follow-up assessments of one arm.[33] In total, the studies included 77411 patients.

Table 1: Description of included studies

Author, Year, Country	Study design	Sampling time	Population	Intervention	Comparison	Outcomes
Farasatkish, 2009[1] Iran	2-group after study	May 2007 through August 2007	N=1716, open-heart surgery, ASA class III-IV	Pre-anaesthesia consultation clinic (3-10 days before surgery)	Usual care (within 24 h of surgery)	Cancellations
Kamal, 2011[2] England	2-group after study	April 2005 through April 2009	N=1445, complex elective orthopaedic surgery, ASA class III-IV	Preoperative anaesthetic assessment clinic (timing not stated)	Usual care (day of surgery)	Admissions, length of stay, mortality, cost
Kamau, 2017[3] Kenya	CBA	August 2000, April 2001, November 2001	N=51, elective non-cardiac surgery, ASA class III	Pre-anaesthesia clinic consultation (≥48 h before surgery)	Usual care (day before surgery)	Anxiety (STAI score)
Klopfenstein, 2000[4] Switzerland	2-group after study (parallel)	No data	N=40, elective endoscopic urological surgery, ASA class I-III	Pre-anaesthetic consultation (1-2 weeks before surgery)	Usual care (the evening before surgery)	Anxiety (MAACL, VAS)
Lee, 2012[5] China	2-group after study (parallel)	March 2007 through November 2009	N=352, elective surgery, ASA class I-IV	Anaesthesia consultation clinic (≤3 months before surgery)	Usual care (the evening before surgery)	Quality of recovery score), cost, cancellations, length of stay, satisfaction, anxiety (VAS), willingness to pay (WTP)

Mendes, 2005[6] Brazil	2-group after study (parallel)	April 2007 through June 2007	N=52254, surgery, ASA class not stated	Preoperative outpatient evaluation clinic (timing not stated)	Usual care (timing not stated)	Cancellations, length of stay
van Klei, 2002[7] The Netherlands	2-group after study	November 2012	N=21553, elective surgery, ASA class mainly I-II	Preoperative outpatient evaluation clinic (average 3 weeks before surgery)	Usual care (day before surgery)	Cancellations, same-day admissions, length of stay

ASA: American Society of Anesthesiology; CBA: controlled before-after; MAACL: Multiple Affect Adjective Check List; STAI: State-Trait Anxiety Inventory; VAS: visual analogue scale;
WTP: willingness to pay

Considering the intervention, PACs in all studies consisted of an outpatient service whereby patients were checked for medical conditions that are important for anaesthesia and informed regarding what to expect on the day of surgery. However, the terminology used for PACs varied; they served different surgical specialities, and the pre-anaesthesia consultation was conducted from ≥48 h to ≤3 months before the surgery. Three were implemented in a university hospital,[31,33,34] one in a teaching hospital,[30] one in a medical centre,[32] and one in a general hospital[29] (one study did not specify the context).[28] The person conducting the pre-anaesthesia consultation also varied: in five studies, it was the anaesthesiologists,[28-31,33] in the other studies it was (also) the orthopaedic senior house officer,[29] the consultant or resident,[34] or the physician.[32] In three studies, nurses were part of the team assessing the patients.[29-31] The comparison group in all studies was usual care, which generally involved performing a preoperative anaesthetic evaluation the day before the surgery on the admitted patients.

Of the 77411 patients in the studies, 9626 and 15531 patients were in the intervention and control groups, respectively. One study did not specify the number of patients in the intervention and control groups, but only the total number of surgeries performed.[33] Five studies reported data for sex, showing that 51% of the patients were women and 49% were men (12129 vs. 11583).[28,30-32,34] There were more females than males both in the intervention (4345 vs. 4134) and the control groups (7784 vs. 7449). Five studies reported data for age showing that all the patients were over 20 years old and grouped within the American Society of Anesthesiology (ASA) category.[28,30-32,34]

The patients were scheduled to undergo a variety of surgeries, including orthopaedic,[29-31,34] urology,[28,30,31,34] general,[30,31,34] heart,[32] gynaecology/obstetrics, [30,31,34] vascular surgery,[30] ophthalmology,[30] maxillofacial/dental surgery, [30,34]neurological surgery,[30] and one did not specify the type of surgery.[33] In five studies, the type of anaesthesia was not specified,[29,30,32-34] and two studies reported patients for general and/or regional supplement.[28,31]

The patients included had previous anaesthetic experience in one study,[28] previous and no previous anaesthetic experience in another,[34] and five studies did not report this data.[29-33] Limited background characteristics of the patients were reported in two studies.[29,33] One stated that the patients included had ASA 3 or 4 and a body mass index of more than 40. However, no ASA number, sex, or age was reported in the article.[29] Mendes *et al*. did not report any background characteristics of the included patients.[33]

Description of the studies' risk of bias

Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the cause and effect were clear. The majority of the studies measured outcomes in the same way and used appropriate statistical analyses. Several studies had limitations of follow-up and similarity in care and participants. None of the patients had multiple pre-and post-measurements.

Outcomes of the included studies

The outcomes of the included studies are described separately below.

Satisfaction

One study reported satisfaction as an outcome.[31] The summarised patient satisfaction with the anaesthetic consultation score out of 100 showed that patients in the PAC group

were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%; *p*=0.01).[31] There was no statistically significant difference between the two groups in the mean patient satisfaction with perioperative anaesthesia care score out of 5 after surgery (mean difference 0.01%, *p*=0.94).[31] The mean quality of recovery (QoR) score (range, 0–18) following anaesthesia on the first day of surgery was similar between the intervention (13.17±2.73) and control (13.31±2.65) groups (*p*=0.67).[31] The QoR measure is the patients' health-related quality of life.[35]

Anxiety

Three studies reported anxiety.[28,31,34] Two studies reported the visual analogue scale (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[28] another used a 100 mm horizontal line with "not anxious at all" to "extremely anxious"[31] In one study, the median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control group (*p*=0.0038).[28] In another study, there were no significant differences between the control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively, *p*=0.12), and anaesthesia (20 vs. 19, respectively, *p*=0.60).[31] The median Multiple Affect Adjective Check List (MAACL) score with possible range scores from 0 to 21 (higher scores indicating greater levels of anxiety) was 3 (0–9) in the intervention group and 6.5 (2–12) in the control group (*p*=0.0053).[28] The differences in the State-Trait Anxiety Index (STAI) score, which is composed of 40 questions rated on a 4-point Likert scale, was 1.51, 95% CI: 1.02–2.02%, *p*=0.0051).[34] The results on anxiety in these two studies were significant. However, Kamau *et al.*[34] found no differences when they examined anxiety and the influences of sex, duration of hospital stay, and prior anaesthesia experience.

Mortality

One study reported the mortality rates.[29] Patients attending the High Dependency Unit (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex orthopaedic surgery had a significant reduction in mortality rate after being assessed in the PAC, from 18 (6.1%) of 298 patients before to 14 (1.2%) of 1147 patients after p=0.001.[29]

Cancellation rate

Three studies reported a reduced cancellation rate following the establishment of a PAC.[30,32,33] One of the included studies had 316 (2.0%) cancellations for medical reasons before the introduction of PAC, and 79 (0.9%) after, and a difference of 1.02% (95% CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%).[30] The overall cancellation of surgery was reduced from 1027 (6.3%) to 393 (4.6%) following surgery, and a difference of 0.9% (95% CI, 0.3–1.0%) when patients were assessed in PAC.[30] Mendes *et al*.[33] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. There were 469 (number of cancellations)/10639 (number of surgeries performed) due to medical reasons in the first year of this study. The following year, a considerable increase above the baseline values in the intervention group was observed, followed by a progressive decrease in the last year with 391 (number of cancellations)/10397 (number of surgeries performed).[33] Farasatkish *et al.* reported that of the 1716 patients studied, 15.1 % of cases cancelled in the two groups. The cancellation rates in the control group were 146/866 (16.8%), and the cancellation rate in the intervention group was 113/850 (13.29%) p=0.046. The most common reason for cancellation was incomplete medical work-up 51/146 (35%) in the control group and 32/113 (28%)in the intervention group, p=0.03).[32] Lee *et al.* found similar rates for surgery being cancelled on the scheduled date for the intervention group compared to the control group (2.3% vs. 3.4%, p=0.75).[31]

Costs and willingness to pay

Two studies reported the costs.[29,31] One study reported a total saving of £ 486.62 per patient after establishing a PAC.[29] Another study reported a significantly lower preoperative cost per patient in the intervention group compared to the control group (mean difference, $ 463; 95% CI, -$648 to -$278 per patient, $p<0.01$).[31] However, the mean difference in the total perioperative treatment cost was not significant, even after adjusting for cancellation on the day of surgery costs.[31] The intervention group patients were willing to pay (WTP) significantly more than the median WTP (US $13) for a clinic consultation at the PAC than the control group.[31]

Length of stay

The length of stay was reported in four studies.[29-31,33] Mendes *et al*.[33] found a significant decrease in mean hospital stay for patients from 6.2 to 5.0 days ($p \leq 0.001$) during the four years of this study. Van Klein *et al.*[30] found that the total admission time significantly decreased from a mean of 8.8 days (before) and a mean of 8.1 days (after) and 0.92 (0.90–0.94). After adjusting for age, sex, and introduction date of PAC this difference was 0.92 (0.90–0.94).[30] Kamal *et al.*[29] found a significant reduction in the length of stay in the high dependency unit from 2.1 days to 1.6 d (p=0.01), and in the intensive care unit from 2.3 days to 1.9 days (p=0.01). In the last study, no significant changes were found in the median duration of postoperative stay between the intervention and control groups.[31]

Organisation planning and efficiency

Organisation planning and efficiency have been reported in two studies.[29,33] One study found statistically significant changes in the reduction of unplanned admissions to the PACU (65/298 [22%], 111/1147 [10%], p=0.001), ICU (4/298 [1.3%], 4/1147 [0.4%], p=0.01), and HDU (4/298 [1.34%], 20/1147 [1.7%], p=0.01) after implementing a PAC.[29] The planned

admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], *p*=0.01), and HDU (14/298 [4.7%], 85/1147 [7.4%], *p*=0.1) increased after implementing a PAC.[29] The number of PAC evaluations increased from year 1, 4704 to year 4, 13990 ($p \leq 0.001$).[33] The number of outpatient procedures increased from 2170 (year 1) to 1943 (year 4) ($p \leq 0.001$), and the inpatient procedures decreased from 9556 (year 1) to 8449 (year 4), ($p \leq 0.001$).[33]

DISCUSSION

This systematic review summarises the effectiveness of PACs in improving quality and patient safety in general hospitals and determines the gaps in existing knowledge for future research. Seven studies that met the inclusion criteria were included. We present the main results and infer the implications for research and practice in the following text.

Cancellation on the day of surgery has undesirable effects on both the patients and the hospital system.[14] Thus, studies have found that late patient-related cancellations could totally or partially be prevented,[36] if they were addressed during preoperative evaluations.[14,15] This is confirmed by several studies in this systematic review that found a reduction in surgery cancellation after implementing a PAC.[30,32,33] However, Lee *et al*. found no significant changes between the intervention and control groups.[31] Mendes and colleagues found that the number of cancellations for medical reasons after PAC implementation decreased in the first year of implementation. In the second and third years, they were higher before the number dropped to below baseline.[33] These conflicting findings might show that hospitals operate in a specific context, with unique populations, processes, and microsystems, which may encounter unique obstacles making implementation difficult. Patient-focused interventions need to consider barriers,

facilitators, and interrelationships between systems, staff, and interventions to increase the likelihood of sustainable success.[37] In addition, Kamau *et al.* also indicated that PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more predictable for patients, staff, and administrations.[34]

Another main finding of this systematic review was a significant reduction in the length of hospital stay following patients' examination in a PAC; however, a small number of studies with low quality were considered. Nevertheless, similar results were found in another systematic review claiming that perioperative systems support hospitals to address the expected growth in the number and complexity of surgical procedures being performed.[15] However, Lee *et al.* indicated that the reason for the reduced length of hospital stay was the mean duration of stay before surgery in the intervention group.[31] This indicates that when patients are examined in the PAC and well prepared with information, consultations, and tests, they do not need to be hospitalised until the day of surgery. A survey focusing on patients operated showed that if they had a choice, 75% do not wish to be admitted to the hospital until the same day of operation. One of the main reasons was to spend less time in the hospital.[38] However, an updated systematic review on the effectiveness of nurse-led preoperative assessment services for elective surgery found that the included articles had a reduced length of stay. The included studies had low methodological quality, and therefore, the authors could not conclude that this service leads to reduced length of hospital stay.[16]

The evidence from this systematic review is insufficient to conclude whether patients have reduced anxiety when assessed using PAC. The included studies used different instruments to measure the levels of anxiety, and the results could not be pooled. In addition, previous

studies have shown that anxiety levels were higher in women.[39] Seventy-eight per cent of the participants were women in one of the included studies in this systematic review and might result in a bias in this study.[34] Anxiety was also statistically higher in patients who underwent general anaesthesia than in those who underwent regional anaesthesia.[40] The included studies on anxiety included both patients with general and regional anaesthesia, which might also be biased. Furthermore, the patients included in this review had both former surgical experience and no experience with surgery. However, studies have shown that former experience with anaesthesia and surgery reduces the risk of preoperative anxiety.[41]

Assessment of PAC was significantly associated with reduced mortality following complex orthopaedic surgery.[29] Previously published retrospective studies found similar results, but with other types of surgery.[42,43] A Danish study found that deaths attributed to anaesthesia were associated with insufficient or inadequate preoperative evaluation.[7] Furthermore, a previous study pointed out that the risk factors are not only patient-related but also organisation-related,[8] and that some hospitals have perioperative care and teams that are better at identifying and rescuing perioperative complications.[44,45] However, Blitz *et al.* argued that PAC should focus on early patient engagement strategies, interdisciplinary team communication, detailed perioperative care plans, and patient documentation in the electronic health record. This record should be open for review by the perioperative team to preserve patient information and safety. The value of a PAC lies in its ability to improve the quality of the perioperative process by designing a more robust system for preoperative assessment and preparation.[42] The importance of safety in

anaesthesia is a vital component in anaesthesia practice, and the use of PACs contributes to this critical area.

Strengths and limitations of the study

Most review steps were performed in duplicate or independently by two researchers, and agreement was reached in a consensus meeting. However, grey literature, such as government and institutional documents, was not included and might be a limitation to this study. Since countries have different organisational structures in their healthcare systems, we did not set inclusion criteria concerning who performed the patient´s preoperative assessment. However, the European Society of Anaesthesiology guidelines recommend that anaesthesiologists complete the preoperative assessment, while trained nurses or anaesthesia trainees perform the screening.[8] A preoperative evaluation performed by an internist has been associated with increased length of stay and increased postoperative mortality.[46] This systematic review's results were possibly affected by the heterogeneity in the types of staff performing the preoperative assessment.

We opted to include only the studies with the highest internal validity. Thus, we excluded several retrospective studies. Nonetheless, the remaining studies´ risk of bias was fairly high, and they were heterogeneous. As a result, meta-analyses were not statistically appropriate.[25] The included studies' designs could not rule out selection bias and confounding, and the strength of the evidence should be assessed cautiously. Many studies did not make adjustments for several confounders, which could be responsible for the observed effects. Several studies lacked descriptions of the methods used and the patients included, which lowered the transparency. It is not very reassuring that many such studies were unable to deliver more thorough evidence to guide practice and should be assessed

cautiously. The results are relevant to health care services, which should focus on the well-being and safety of the patients.

Implications for future research and practice

This systematic review identified the ambiguity in the PAC interventions offered to the intervention group. In many studies, it was evident that the methods used in these studies were not always clearly described, and high-quality research is needed in this field. The included studies in this review did not contain any results of reduced preoperative tests, such as blood tests, on patients before surgery when patients attended the PAC,[47,48] and earlier surgical room entry time for patients assessed in PACs,[49,50] similar to previous retrospective studies. Other implications for future research might be the organisation structure of different PACS and their functioning. The use of technology, such as streaming services, facilitates different types of patient groups and might be more important with the appearance of Covid-19 in reducing human contact and spread of the virus.

CONCLUSION

This systematic review suggests that PAC use reduces the length of hospital stay, and the majority of the studies had reduced the cancellation rate in hospitals. These findings are an essential contribution to the current evidence in this field. In addition to further research in this field, the demand for increased high-quality studies to capture robust data describing the quality of care and clinical outcomes for patients requiring anaesthesia. This step demands increased focus and funding for this specific area of health services research and could, therefore, lead to new implementations of PAC`s in health care services and further develop patient safety in perioperative care.

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Competing Interests

The authors declare that they have no conflict of interest.

Data sharing statement

All data relevant to the study are included within the article or have been uploaded within supplemental files.

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Author statement

EWK, MF, AO and TOT: Study design

EWK, MF: Search and screening of the articles

EWK: Data extraction

MF, AO, RB and TOT: Control of data extraction

EWK, MF, AO and RB: Quality assessment of the included articles

EWK: Drafting of the manuscript

MF, AO, RB, and TOT: Contribution to and review of the final version of the manuscript

MF, AO, RB and TOT: Supervised the study

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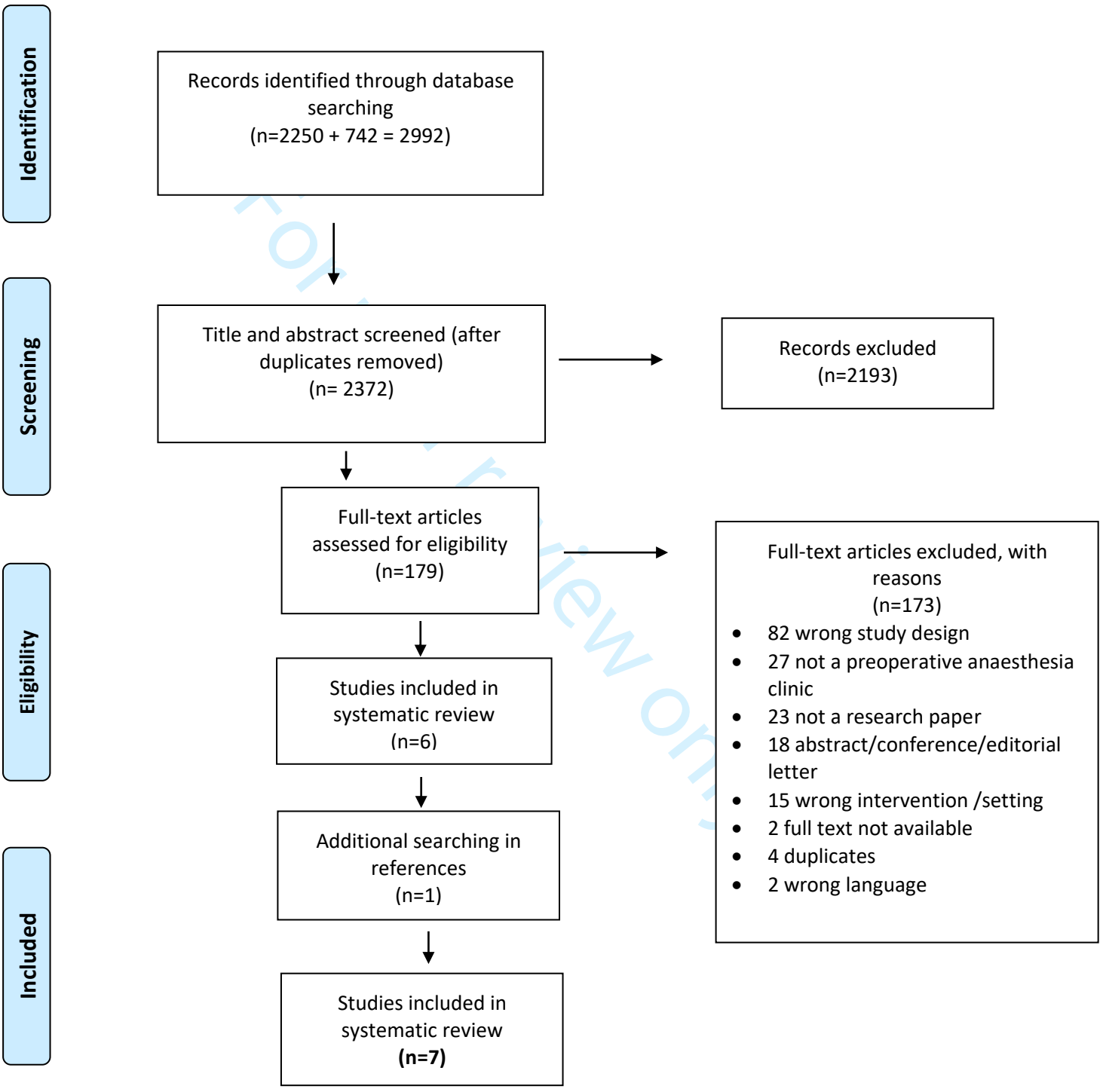
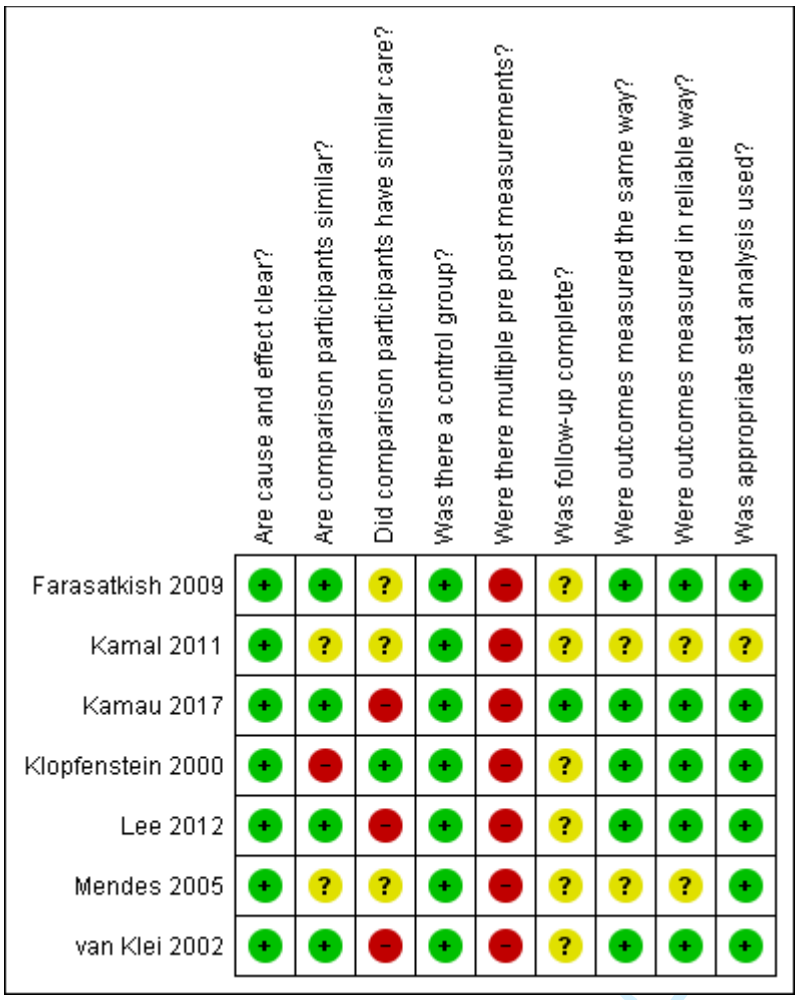
Figure 1: PRISMA Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Figure 2: The risk of bias assessment



Database: Ovid MEDLINE(R) ALL <1946 to February 03, 2020>

Search Strategy:

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1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti. (6182)

2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti. (1472922)

3 1 and 2 (478)

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab. (572)

5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab. (241)

6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab. (138)

7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab. (4)

8 or/3-7 (1409)

9 limit 8 to yr="1996 -Current" (1105)

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Reporting checklist for systematic review and meta-analysis.

Based on the PRISMA guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the PRISMAreporting guidelines, and cite them as:

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement

		Reporting Item	Page Number
Title			
	#1	Identify the report as a systematic review, meta-analysis, or both.	1
Abstract			
Structured summary	#2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	2
Introduction			
Rationale	#3	Describe the rationale for the review in the context of what is already known.	3-5

Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
Methods			
Protocol and registration	#5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address) and, if available, provide registration information including the registration number.	5
Eligibility criteria	#6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rational	6
Information sources	#7	Describe all information sources in the search (e.g., databases with dates of coverage, contact with study authors to identify additional studies) and date last searched.	6
Search	#8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5 + APPENDIX
Study selection	#9	State the process for selecting studies (i.e., for screening, for determining eligibility, for inclusion in the systematic review, and, if applicable, for inclusion in the meta-analysis).	6
Data collection process	#10	Describe the method of data extraction from reports (e.g., piloted forms, independently by two reviewers) and any processes for obtaining and confirming data from investigators.	6
Data items	#11	List and define all variables for which data were sought (e.g., PICOS, funding sources), and any assumptions and simplifications made.	5-6
Risk of bias in individual studies	#12	Describe methods used for assessing risk of bias in individual studies (including specification of whether this was done at the study or outcome level, or both), and how this information is to be used in any data synthesis.	6
Summary measures	#13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A

Planned methods of analyis	#14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis.	7
Risk of bias across studies	#15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	11-12
Additional analyses	#16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
Results			
Study selection	#17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8
Study characteristics	#18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citation.	N/A
Risk of bias within studies	#19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	11-12
Results of individual studies	#20	For all outcomes considered (benefits and harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	14-17
Synthesis of results	#21	Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency.	14-17
Risk of bias across studies	#22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	#23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
Discussion			
Summary of Evidence	#24	Summarize the main findings, including the strength of evidence for each main outcome; consider their relevance	18-20

		to key groups (e.g., health care providers, users, and policy makers	
Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	20-21
Conclusions	#26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22
Funding			
Funding	#27	Describe sources of funding or other support (e.g., supply of data) for the systematic review; role of funders for the systematic review.	23

BMJ Open

Effectiveness of pre-anaesthetic assessment clinic: a systematic review of randomised and non-randomised prospective controlled studies

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Effectiveness of pre-anaesthetic assessment clinic: a systematic review of randomised and non-randomised prospective controlled studies

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Word count: 3973

ABSTRACT

Objectives: The aim of this systematic review was to examine the effectiveness of pre-anaesthetic assessment clinics (PACs) implemented to improve quality and patient safety in perioperative care.

Design: Systematic review.

Data sources: The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) were systematically searched from 1st April, 1996 to 4th February, 2021.

Eligibility criteria: The main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs.

Data extraction and synthesis: Titles, abstracts, and full texts were screened by a team of three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal checklist for quasi-experimental studies. Data extraction was performed by one author and checked by four other authors. Results were synthesised narratively owing to the heterogeneity of the included studies.

Results: Seven prospective controlled studies, on the effectiveness of PACs, were included. Three studies reported a significant reduction in the length of the hospital stay, and two studies reported a significant reduction in cancellation of surgery for medical reasons when patients were seen in the PAC. In addition, the included studies presented mixed results regarding anxiety in patients. Most studies had a high risk of bias.

Conclusion: This systematic review demonstrated a reduction in the length of hospital stay and cancellation of surgery when the patients had been assessed in the PAC. There is a need for high-quality prospective studies to gain a deeper understanding of the effectiveness of PACs.

PROSPERO registration number: CRD42019137724

Keywords: pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic review

Strengths and Limitations of this study

- An extensive database search was conducted with no limitations on outcomes and the type of pre-anaesthetic assessment clinic.
- Only randomised or non-randomised prospective controlled studies were included.
- The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.
- The included studies were heterogeneous and had high risk of bias, which is a major limitation of this review.

INTRODUCTION

Anaesthesia is crucial in surgery. However, it may activate physiological changes that increase morbidity and mortality, [1] depending on the patients' preoperative health status and age. [2] Hospitals treat patients with complex, comorbid healthcare problems undergoing progressively extensive surgeries and interventions. [3,4] To ensure the quality and safety of anaesthesia and surgery, precise knowledge of the clinical characteristics of patients undergoing surgery is critical to the perioperative treatment plan. [2] Over the past 50 years, perioperative mortality, including anaesthesia-related mortality, has declined, which is significant in developed countries, [1,5] mainly due to new anaesthetics, improved monitoring equipment and training, availability of recovery rooms, and improved airway management. [4] However, an Australian study reported that 14% of anaesthetic-surgical complications and 39% of deaths attributed to anaesthesia were associated with insufficient and/or inadequate preoperative evaluation. [6] A Danish retrospective investigation showed that the deaths among patients undergoing surgery could be prevented by thorough preoperative evaluation, [7] indicating that risk factors are both patient-and surgery-related and linked to organisational structures. [8] Future efforts should improve preoperative

anaesthesia safety, [9] by improving planning and preparation for elective procedures and interventions.

Today, an increasing number of pre-anaesthesia assessment clinics (PACs) support hospitals internationally in handling the rising number of patients and complexity of surgical procedures. [10] The design of PACs differs crtically based on location, organisational structure, timing, and patient groups. They primarily function as a service unit for surgeons, patients, and the anaesthetic team. [11] The PAC consultation, by the anaesthesiologist, anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the patients' medical condition prior to surgery and anaesthesia. [2] Thus, it is essential for secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk patients, improves patient outcomes, prepares the patient physically and psychologically for anaesthesia, and ensures the patient's most favourable condition for surgery and anaesthesia. [12-14] This is primarily performed by interviewing and examining the patient, reviewing previous medical, surgical and anaesthesia issues, detailed description of current medication, and provisions for obtaining and reviewing preoperative tests. [11] PACs also lead to increased communication between healthcare providers and coordination with postoperative care. [15,16] Due to well-prepared patients and staff, several researchers posit that with PAC, the number of surgical cancellations, length of hospital stay, and mortality rate have reduced, and tests are minimised. [8,17,18] Others assert that patients feel less anxious regarding the subsequent anaesthetic and surgical processes and are highly satisfied with the service with PAC consultations. [17,19,20]

As Turunen *et al.* stated, research on PACs is scarce regarding costs, financial savings, the impact on patient safety and quality of care, accuracy of operative patients, and effect on

preoperative nursing levels. [21] Survey results indicate that anaesthesiologists perceive day of surgery delays due to missing information as common, even with PAC consultations. [22] This systematic review aimed to examine the effectiveness of PACs in improving quality and patient safety in preoperative care. Further, we aimed to determine the gaps in existing knowledge for future research.

METHODS

Our systematic review followed the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions [23] and was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. [24] The protocol was registered in PROSPERO: CRD42019137724. [25]

The two review questions were:

1. Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?
2. Is PAC effective in reducing cancellation rate, cost, and improving efficiency?

Search strategies

We performed a scoping search in different databases to identify the key terms. [26,27] The final search was planned and conducted in close collaboration with a university librarian. On 11th September, 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP), which was updated on 3th February 2020 and 4th February, 2021. Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words such as preanaesthesia, nurse, surgery, anaesthesia, preoperative, assessment, measurement, evaluate, preadmission, centre, clinic, ward, unit, and outpatient. The searches are detailed in Appendix 1. The search mode in CINAHL was Boolean/Phase, which supports Boolean searching or exact phrase searching. For comprehensiveness, we used both the truncation

and proximity operators. We limited the search to 1996, the year one of the first known articles in this area was published. [28] Complementary methods to identify studies included following up on citations via Scopus, scanning the reference lists of relevant papers and included articles, and checking for relevant studies in clinical trials. [26]

Eligibility criteria

The main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English or Scandinavian language, (b) scientific publication of original research, (c) reported the outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-randomised prospective controlled studies, and (f) newly established PAC. We excluded: (a) editorials, discussions, and conference abstracts, (b) reviews, (c) instrument testing, (d) studies on children, and (e) retrospective studies.

Study selection

All references identified in the search were transferred to EndNoteX9, where the duplicates were removed. Subsequently, all unique references were transferred to the Covidence screening tool. [29] Study eligibility was ascertained independently, first at the title and abstract level, and subsequently at the full text. Three of the authors screened all the articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were resolved by consulting RCB and TOT.

Quality assessment

Risk of bias in studies were assessed using design specific checklists. Given the methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used. [30] Author EWK performed the risk of

bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through discussion with MF and AO. Each of the nine checklist questions was answered no, yes, unclear (or not applicable).

Data extraction and analysis

Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the authors confirmed the accuracy, consistency, and completeness of the extracted data that included publication details, study design, setting, and characteristics of the patients, interventions, comparisons, and outcome (PICO). We requested information on the missing data; however, received no response from the authors. If the PICO elements were sufficiently similar and statistical data available, we intended to conduct meta-analyses. However, the extracted data revealed substantial heterogeneity. Therefore, we performed narrative synthesis, describing and comparing the main findings from the included studies, and discussing their methodological strengths and weaknesses.

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research. However, the project is initiated by health professionals.

RESULTS

Figure 1. provides details of the study selection process. A total of 2,981 records were identified in the final search (2021). After removing duplicates, we screened 2,058 records based on the title and abstract; 179 records passed the full-text screening. We included seven studies that met the inclusion criteria.

Overall characteristics of the studies

The seven studies are listed in Table 1. They were all in English and published between 2000–2017, with data collected in the years 1997–2015 (one study did not report data collection information). [31] Based on inclusion criteria, all were prospective controlled studies; however, no RCTs were found. There was one controlled before-after study. [32] The rest six studies had control groups; assessments followed PAC implementation, without baselinee assessments. There were three 2-group non-parallel after-only studies, [33-35] and three 2-group parallel after-only studies [31]; one had a matched control group [36] and one had three follow-up assessments of one arm. [37] One study had only cancellation rate as prospective data. [33] The studies included 77,411 patients.

186 **Table 1: Description of included studies**

Author, Year, Country	Study design	Sampling time	Population	Intervention	Comparison	Outcomes
Farasatkish,2009[34] Iran	2-group after study	May 2007 through August 2007	N=1716, open-heart surgery, ASA class III-IV	Pre-anaesthesia consultation clinic (3-10 days before surgery)	Usual care (within 24 h of surgery)	Cancellations
Kamal,2011[35] England	2-group after study	April 2005 through April 2009	N=1445, complex elective orthopaedic surgery, ASA class III-IV	Preoperative anaesthetic assessment clinic (timing not stated)	Usual care (day of surgery)	Admissions, length of stay, mortality, cost
Kamau,2017[32] Kenya	CBA	August 2000, April 2001, November 2001	N=51, elective non-cardiac surgery, ASA class not stated	Pre-anaesthesia clinic consultation (≥48 h before surgery)	Usual care (day before surgery)	Anxiety (STAI score)
Klopfenstein,2000[31] Switzerland	2-group after study (parallel)	No data	N=40, elective endoscopic urological surgery, ASA class I-III	Pre-anaesthetic consultation (1-2 weeks before surgery)	Usual care (the evening before surgery)	Anxiety (MAACL, VAS)
Lee,2012[36] China	2-group after study (parallel)	March 2007 through November 2009	N=352, elective surgery, ASA class I-IV	Anaesthesia consultation clinic (≤3 months before surgery)	Usual care (the evening before surgery)	Quality of recovery score, cost, cancellations, length of stay, satisfaction, anxiety (VAS),

						willingness to pay (WTP)
	Mendes,2005[37] Brazil	2-group after study (parallel)	April 2007 through June 2007	N=52254, surgery, ASA class not stated	Preoperative outpatient evaluation clinic (timing not stated)	Usual care (timing not stated)	Cancellations, length of stay
	van Klei,2002[33] The Netherlands	2-group after study	November 2012	N=21553, elective surgery, ASA class not stated	Preoperative outpatient evaluation clinic (average 3 weeks before surgery)	Usual care (day before surgery)	Cancellations

ASA: American Society of Anesthesiology; CBA: controlled before-after; MAACL: Multiple Affect Adjective Check List; STAI: State-Trait Anxiety Inventory; VAS: visual analogue scale; WTP: willingness to pay

Considering the intervention, PACs in all studies comprised an outpatient service whereby patients were examined for medical conditions important for anaesthesia and informed regarding expectations on the day of surgery. Nevertheless, the terminology used for PACs varied, they served different surgical specialities, and conducted pre-anaesthesia consultation from ≥48 h to ≤3 months before the surgery. The settings included university hospital (n=3), [32,36,37] teaching hospital (n=1), [33] medical centre(n=1), [34] and general hospital (n=1) [35]; one study did not specify the context.[31] The staff conducting the pre-anaesthesia consultation also varied: in five studies, it was the anaesthesiologists, [31,33,35-37] in the other studies it was (also) the orthopaedic senior house officer, [35] the consultant or resident, [32] or the physician. [34] In three studies, nurses were part of the team. [33,35,36] The comparison in all studies was usual care, which generally involved a preoperative anaesthetic evaluation of the admitted patients the day before the surgery.

Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and control groups, respectively. One study did not specify the number of patients in the intervention and control groups, but only the total number of surgeries performed. [37] Five studies reported data for sex, showing that 51% of the patients were women and 49% were men (12,129 vs. 11,583). [31-34,36] There were more women than men in both the intervention (4,345 vs. 4,134) and the control groups (7,784 vs. 7,449). Five studies reported data for age showing that all the patients were over 20 years old [31-34,36] and four studies had grouped within the American Society of Anesthesiology (ASA) category. [31,34-36]

The patients were scheduled to undergo a variety of surgeries, including orthopaedic, [32,33,35,36] urology, [31-33,36] general, [32,33,36] heart, [34] gynaecology/obstetrics,

[32,33,36] vascular surgery, [33] ophthalmology, [33] maxillofacial/dental surgery, [32,33]neurological surgery, [33] while one did not specify the type. [37] In five studies, the type of anaesthesia was not specified, [32-35,37] and two studies reported patients for general and/or regional supplement. [31,36]

The patients included had previous anaesthetic experience in one study, [31] previous and no previous anaesthetic experience in another, [32] and five studies did not report this data. [33-37] Limited background characteristics of the patients were reported in two studies. [35,37] One stated that the patients included had ASA 3 or 4 and a body mass index >40; however, no ASA number, sex, or age was reported. [35] Mendes *et al*. did not report any background characteristics of the included patients. [37]

Description of risk of bias in the studies

Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the cause and effect were clear. The majority of the studies measured outcomes similarly and used appropriate statistical analyses. Several studies had limitations of follow-up and similarity in care and participants. None of the patients had multiple pre-and post-measurements.

Outcomes of the included studies

The outcomes of the included studies are each described separately below.

Satisfaction

One study reported satisfaction as an outcome. [36] The summarised patient satisfaction with the anaesthetic consultation score out of 100 showed that patients in the PAC group were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%; p=0.01). [36] There was no statistically significant difference between the two groups in

mean patient satisfaction with perioperative anaesthesia care score out of 5 after surgery (mean difference 0.01%, p=0.94). [36] The quality of recovery (QoR) measure is the patients' quality of recovery score. [38] The mean QoR score (range, 0–18) following anaesthesia on the first day after surgery was similar between the intervention (13.17±2.73) and control (13.31±2.65) groups (p=0.67). [36]

Anxiety

Three studies reported anxiety. [31,32,36] Two studies reported the visual analogue scale (VAS), one rated from zero (no anxiety) to ten (very high anxiety), [31] another used a 100 mm horizontal line with "not anxious at all" to "extremely anxious [36]" In one study, the median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control group (p=0.0038). [31] In another study, there were no significant differences between the control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively, p=0.12), and anaesthesia (20 vs. 19, respectively, p=0.60). [36] The median Multiple Affect Adjective Check List (MAACL) score, with possible range of scores 0–21 (higher scores indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in the control group (p=0.0053). [31] The differences in the State-Trait Anxiety Index (STAI) score, which comprising 40 questions rated on a 4-point Likert scale, was 1.51, 95% CI: 1.02–2.02%, p=0.0051). [32] The results on anxiety in these two studies were significant. However, Kamau *et al.* found no differences on examining anxiety and the influences of sex, duration of hospital stay, and prior anaesthesia experience. [32]

Mortality

One study reported the mortality rates. [35] Patients attending the High Dependency Unit (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex

orthopaedic surgery had a significant reduction in mortality rate after being assessed in the PAC, from 18 (6.1%) of 298 patients before to 14 (1.2%) of 1147 patients after *p*=0.001. [35]

Cancellation rate

Four studies reported reduced cancellation rates following the establishment of a PAC. [33,34,36,37] One of the included studies had 316 (2.0%) cancellations for medical reasons before the introduction of PAC, and 79 (0.9%) after, and a difference of 1.02% (95% CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%). [33] The overall cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following surgery, and a difference of 0.9% (95% CI, 0.3–1.0%) when patients were assessed in PAC. [33] Mendes *et al*. [37] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. There were 469 (number of cancellations)/10,639 (number of surgeries performed) due to medical reasons in the first year of this study. The following year, a considerable increase above the baseline in the intervention group was observed, followed by a progressive decrease in the last year with 391 (number of cancellations)/10397 (number of surgeries performed). [37] Farasatkish *et al.* reported that of the 1,716 patients studied, 15.1 % cancelled in the two groups. The cancellation rates in the control and intervention groups were 146/866 (16.8%) and 113/850 (13.29%) (p=0.046), respectively. The most common reason for cancellation was incomplete medical work-up; 51/146 (35%) in the control group and 32/113 (28%) in the intervention group (p=0.03). [34] Lee *et al.* found similar rates for surgery being cancelled on the scheduled date for the intervention group compared to the control group (2.3% vs. 3.4%, *p*=0.75). [36]

Costs and willingness to pay

Two studies reported the costs. [35,36] One study reported a total saving of £ 486.62 per patient after establishing a PAC. [35] Another reported a significantly lower preoperative cost per patient in the intervention group compared to the control group (mean difference, $ 463; 95% CI, -$648 to -$278 per patient, $p<0.01$). [36] However, the mean difference in the total perioperative treatment cost was not significant, even after adjusting for cancellation on the day of surgery costs. [36] The intervention group patients were willing to pay (WTP) significantly more than the median WTP (US $13) for a clinic consultation at the PAC than the control group. [36]

Length of stay

The length of stay was reported in three studies. [35-37] Mendes *et al*. [37] found a significant decrease in mean hospital stay of patients from 6.2 to 5.0 days ($p \leq 0.001$) during the four years of this study. Kamal *et al.* [35] found a significant reduction in the length of stay in the high dependency unit from 2.1 days to 1.6 d ($p=0.01$), and in the intensive care unit from 2.3 days to 1.9 days ($p=0.01$). In the last study, no significant changes were found in the median duration of postoperative stay between the intervention and control groups. [36]

Organisation planning and efficiency

Organisation planning and efficiency have been reported in two studies. [35,37] One study found statistically significant changes in the reduction of unplanned admissions to the PACU (65/298 [22%], 111/1147 [10%], $p=0.001$), ICU (4/298 [1.3%], 4/1147 [0.4%], $p=0.01$), and HDU (4/298 [1.34%], 20/1147 [1.7%], $p=0.01$) after implementing a PAC. [35] The planned admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p=0.01$), and HDU (14/298 [4.7%], 85/1147 [7.4%], $p=0.1$) increased after implementing a PAC. [35] The number of PAC evaluations increased from year 14,704 to year 413,990 ($p\leq 0.001$). [37] The number of

outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$), and the inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4), ($p \leq 0.001$). [37]

DISCUSSION

This systematic review summarises the effectiveness of PACs in improving quality and patient safety in general hospitals and determines the gaps in existing knowledge for future research. Seven studies met the inclusion criteria. Herein, we present the main results and infer the implications for research and practice.

Cancellation on the day of surgery has undesirable effects on both the patients and the hospital system. [14] Studies have found that late patient-related cancellations could totally or partially be prevented, [39] if addressed during preoperative evaluations. [14,17] This is confirmed by only three studies in this systematic review that found a reduction in surgery cancellation after implementing a PAC. [33,34,37] However, Lee *et al*. found no significant changes between the intervention and control groups. [36] Mendes *et al.* found that the number of cancellations for medical reasons after PAC implementation decreased in the first year of implementation. In the second and third years, they were high before the number dropped to below baseline. [37] These conflicting findings might show that hospitals operate in specific contexts, with unique populations, processes, and microsystems, encountering unique obstacles, making implementation difficult. Patient-focused interventions should consider barriers, facilitators, and interrelationships between systems, staff, and interventions to increase the likelihood of sustainable success. [40] Addition, Kamau *et al.* indicated that PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more predictable for patients, staff, and administrations. [32]

Another finding of this systematic review was a significant reduction in the length of hospital stay following patients' examination in a PAC; however, a small number of studies with low quality were considered. Nevertheless, similar results were found in another systematic review claiming that perioperative systems support hospitals addressing the expected growth in the number and complexity of surgical procedures. [17] When patients are examined in the PAC and well-prepared with information, consultations, and tests, they need not be hospitalised until the day of surgery. A survey on operated patients showed that given a choice, 75% do not wish admission to the hospital until the day of operation; a major reason being shorter hospital stay. [41] However, an updated systematic review on the effectiveness of nurse-led preoperative assessment services for elective surgery found that the included articles demonstrated a reduced length of stay; these studies had low methodological quality, and therefore, the authors could not conclude that this service leads to reduced length of hospital stay. [18]

The evidence from our systematic review is insufficient to conclude whether patients have reduced anxiety due to PAC. The included studies used different instruments for measuring anxiety levels, and the results could not be pooled. [42]

A major purpose of establishing a PAC in a hospital is to better prepare the patients for the anticipated surgery. Healthcare professionals and policymakers are exploring strategies to reduce unnecessary investigations without compromising quality and patient safety. [43] Translation of evidence-based interventions into hospital systems can provide instant and substantial benefits to patients care and outcomes. However, existing literature describes

barriers and facilitators to implementation related to the system, staff and the intervention. [40] “Routine preoperative laboratory tests” on relatively healthy patients are not recommended from the American Society of Anesthesiologist (ASA), [16] and the National Institute of Health and Care Excellence (NICE). [44] Instead, they encourage for patient and surgery- specific investigations. This recommendation is not always implemented in hospital protocols or practiced for several reasons. Furthermore, an observational study found that routine pre-operative testing to predict abnormalities found at least one abnormal test results in most of the relatively healthy patients. Only 0.67% of the abnormalities had significant impact on changing the perioperative management. [45] Blitz *et al.* argued that PACs should focus on early patient engagement strategies, interdisciplinary team communication, detailed perioperative care plans, and patient documentation using electronic health record that should be open for review by the perioperative team to preserve patient information and safety. [15] Furthermore, a previous study pointed out that the risk factors are not only patient-related but also organisation-related, [8] and that some hospitals have perioperative care teams that are better at identifying and relieving perioperative complications. [46,47] This suggests that the value of PACs lies in their ability to improve the quality of the perioperative process by designing a more robust system for preoperative assessment and preparation. [15] A Danish study found that deaths attributed to anaesthesia were associated with inadequate preoperative evaluation. [7] However, the assessment of PAC was significantly associated with reduced mortality following complex orthopaedic surgery in only one study in this systematic review. [35] Retrospective studies have reported similar results, but with different surgeries. [15,48]

Strengths and limitations of the study

The review was performed in duplicate or independently by two researchers, and consensus was reached through discussion. However, grey literature, such as government and institutional documents, were excluded and might be a limitation of this study. Since organisation of healthcare systems vary in countries, the type of staff who performed the patient´s preoperative assessment was not considered an inclusion criterion. The European Society of Anaesthesiology guidelines recommend that anaesthesiologists complete the preoperative assessment, while trained nurses or anaesthesia trainees perform the screening. [8] A preoperative evaluation performed by an internist was associated with increased length of stay and increased postoperative mortality. [49] This systematic review results were possibly affected by the heterogeneity in the types of staff performing the preoperative assessment.

We exclusively included studies with high internal validity. Therefore, we excluded several retrospective studies. Nonetheless, remaining studies´ risk of bias was fairly high, and were heterogeneous and meta-analyses were not statistically appropriate. [27] The included studies' designs could not rule out selection bias and confounding, and the strength of the evidence should be assessed cautiously. Many studies did not make adjustments for several confounders, which could be responsible for the observed effects. Several studies lacked descriptions of the methods used and the patients included, lowering transparency. It is not very reassuring that many such studies were unable to deliver more thorough evidence to guide practice and should be assessed cautiously. The results are relevant to health care services, focusing on the well-being and safety of the patients.

Implications for future research and practice

This systematic review identified the ambiguity in the PAC interventions offered to the intervention group. In many studies, it was evident that the methods used lacked clarity, and high-quality research is needed in this field. The studies included in this review did not contain any results of earlier surgical room entry time for patients assessed in PACs, [50,51] reduced preoperative tests, such as blood tests, in patients before surgery after attending the PAC, similar to previous retrospective studies. [28,52]

Other implications for future research might include the organisation structure of different PACs and their functioning. Additionally, the tests that should be part of assessement at PACs should be investigated. The use of technology, such as streaming services, facilitates different patient groups and might become crucial for reducing human contact and spread of the virus in context of Covid-19.

CONCLUSION

PAC use has reduced the length of stay and cancellation rate at hospitals. However, the effectiveness of PAC, the major review question, remains unclear, and requires further research. There is a demand for high-quality studies capturing robust data describing the quality of care and clinical outcomes for patients requiring anaesthesia. This requires increased focus and funding for this specific area of health services research and could, therefore, lead to implementations of PACs in health care services and improve patient safety and perioperative care.

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Competing Interests

The authors declare that they have no conflict of interest.

Data sharing statement

All data relevant to the study are included within the article or have been uploaded within supplemental files.

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Author contributions

EWK, MF, AO and TOT: Study design

EWK, MF, AO: Search and screening of the articles

EWK: Data extraction

MF, AO, RCB and TOT: Control of data extraction

EWK, MF, AO and RCB: Quality assessment of the included articles

EWK: Drafting of the manuscript

MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript

MF, AO, RCB and TOT: Supervised the study

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Figure legends

Figure 1: Prefferd Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [24]

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [30]

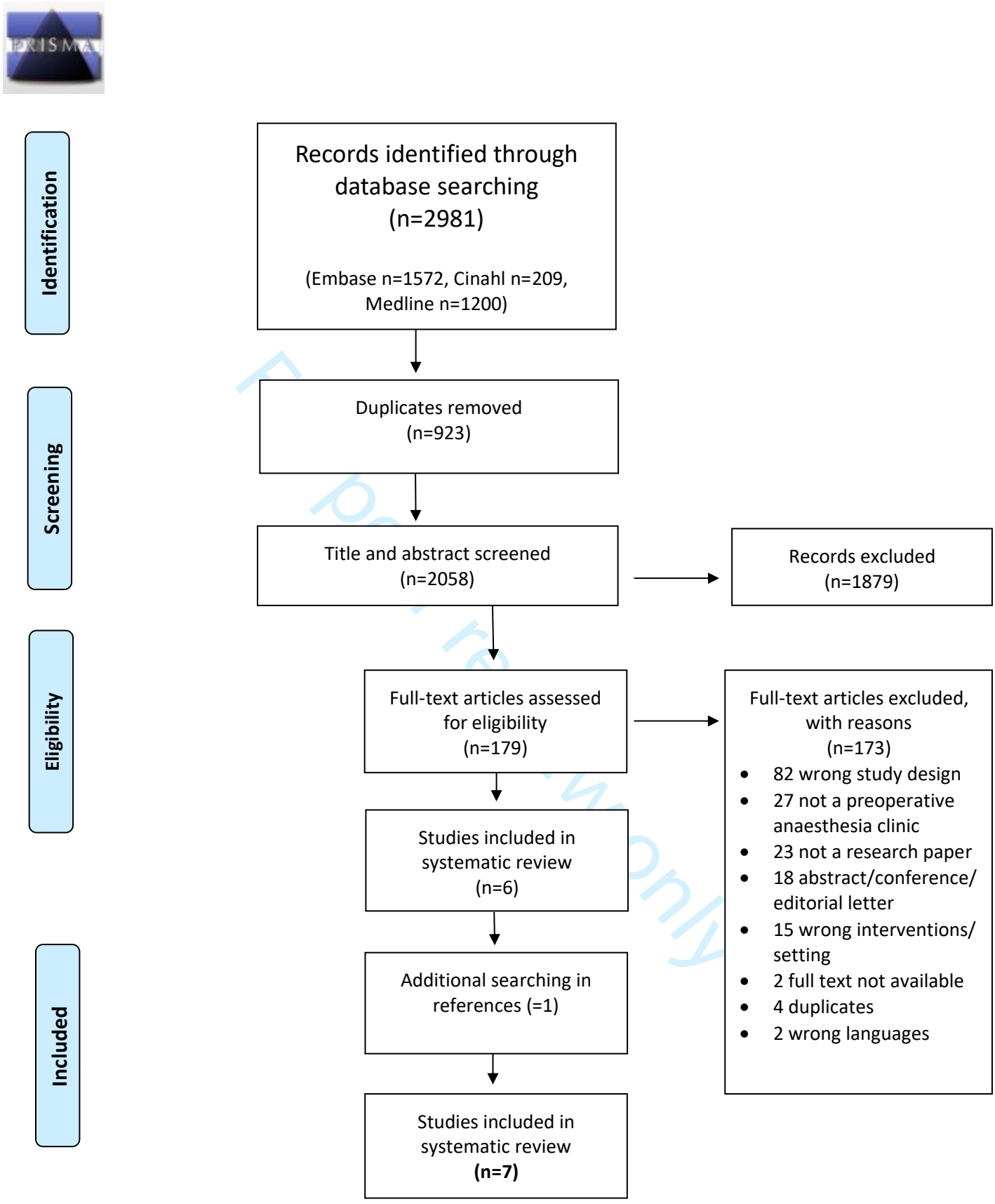

Figure 1: Prefferd Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [24]

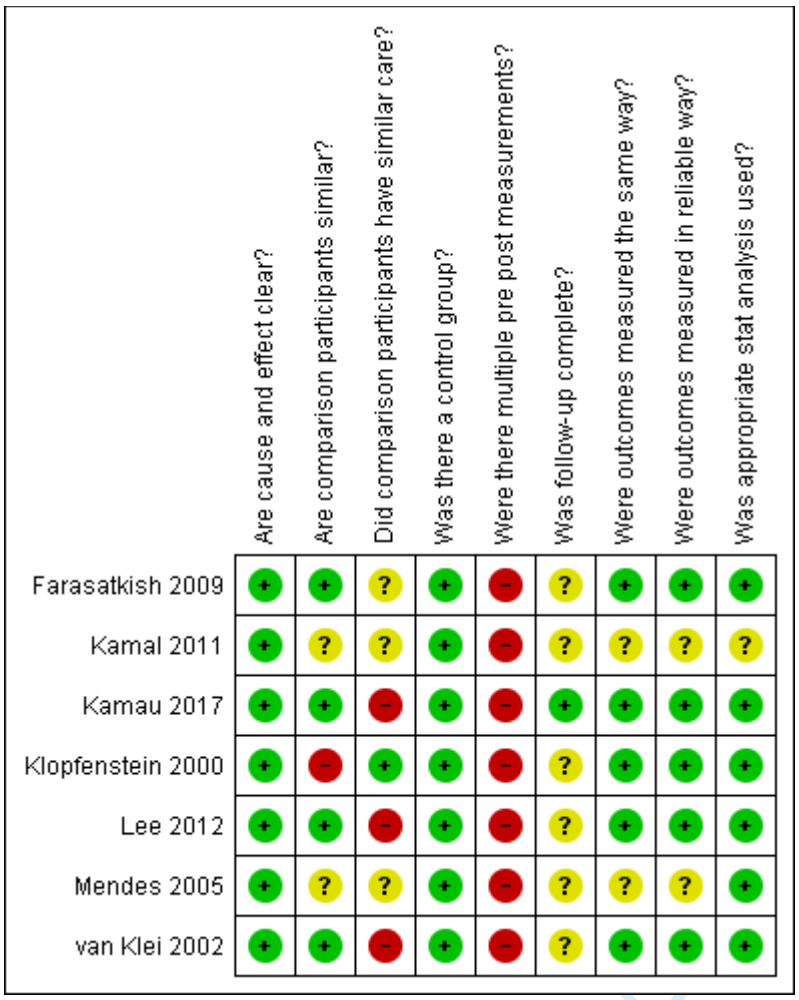

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [30]

Appendix 1: Search strategies

Table of Content

1. Database Search Strategies

The search mode for CINAHL was Boolean/Phrase. For those searches that are done without search fields - it is automatically searched in the standard fields that CINAHL uses, including words from title, summary, and subject headings.
Search 1 and Search 2 are with words in the title (TI in front of the keywords), however this have not been done with the other searches.

Embase and Medline have the same search mode because we are searching for words from title, summary, and subject headings.

2. Initial searches, 11 September 2018

2.1. Main Databases

Database: Embase, (Ovid)

Results: n=1287
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab. (689)
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=997
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 remove duplicates from 9

Database: Cinahl Plus with Full Text (EBSCOhost)

Results: n=132
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-20181231; Exclude MEDLINE records

3. Search update, 3 February 2020

3.1. Main Databases

Database: Embase (Ovid)

Results: n=1453
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1105
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=166
Search:
1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
7 S3 OR S4 OR S5 OR S6 OR S7 487
8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

4. Search update, 4 February 2021

4.1. Main Databases

Database: Embase (Ovid)

Results: n=1572
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1200
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.

5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab. (4)
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=209
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

Reporting checklist for systematic review and meta-analysis.

Based on the PRISMA guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMAreporting guidelines, and cite them as:

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement

		Reporting Item	Page Number
Title			
	#1	Identify the report as a systematic review, meta-analysis, or both.	1
Abstract			
Structured summary	#2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	2
Introduction			
Rationale	#3	Describe the rationale for the review in the context of what is already known.	3-5

Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
Methods			
Protocol and registration	#5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address) and, if available, provide registration information including the registration number.	5
Eligibility criteria	#6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rational	6
Information sources	#7	Describe all information sources in the search (e.g., databases with dates of coverage, contact with study authors to identify additional studies) and date last searched.	5,6
Search	#8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5,6 + APPENDIX 1
Study selection	#9	State the process for selecting studies (i.e., for screening, for determining eligibility, for inclusion in the systematic review, and, if applicable, for inclusion in the meta-analysis).	6
Data collection process	#10	Describe the method of data extraction from reports (e.g., piloted forms, independently by two reviewers) and any processes for obtaining and confirming data from investigators.	6-7
Data items	#11	List and define all variables for which data were sought (e.g., PICOS, funding sources), and any assumptions and simplifications made.	5-7
Risk of bias in individual studies	#12	Describe methods used for assessing risk of bias in individual studies (including specification of whether this was done at the study or outcome level, or both), and how this information is to be used in any data synthesis.	6-7

Summary measures	#13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Planned methods of analyis	#14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis.	7
Risk of bias across studies	#15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	12
Additional analyses	#16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
Results			
Study selection	#17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8
Study characteristics	#18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citation.	N/A
Risk of bias within studies	#19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	12 + Figure
Results of individual studies	#20	For all outcomes considered (benefits and harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	12-16
Synthesis of results	#21	Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency.	12-16
Risk of bias across studies	#22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	#23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
Discussion			

Summary of Evidence	#24	Summarize the main findings, including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers	16-19
Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	19
Conclusions	#26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20
Funding			
Funding	#27	Describe sources of funding or other support (e.g., supply of data) for the systematic review; role of funders for the systematic review.	21

BMJ Open

Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and non-randomised prospective controlled studies

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Keywords:	Adult anaesthesia < ANAESTHETICS, Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Adult surgery < SURGERY

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Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and non-randomised prospective controlled studies

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Word count: 4156

ABSTRACT

Objectives: The aim of this systematic review was to examine the effectiveness of pre-anaesthesia assessment clinics (PACs) in improving the quality and safety of perioperative patient care.

Design: Systematic review.

Data sources: The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) were systematically searched on 11 September 2018 and updated on 3 February 2020 and 4 February 2021.

Eligibility criteria: The inclusion criteria for this study were studies published in English or Scandinavian language and scientific original research that included randomised or non-randomised prospective controlled studies. Additionally, studies that reported the outcomes from a PAC consultation with the patient present were included.

Data extraction and synthesis: Titles, abstracts, and full texts were screened by a team of three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal checklist for quasi-experimental studies. Data extraction was performed by one author and checked by four other authors. Results were synthesised narratively owing to the heterogeneity of the included studies.

Results: Seven prospective controlled studies on the effectiveness of PACs, were included. Three studies reported a significant reduction in the length of hospital stay and two studies reported a significant reduction in cancellation of surgery for medical reasons when patients were seen in the PAC. In addition, the included studies presented mixed results regarding anxiety in patients. Most studies had a high risk of bias.

Conclusion: This systematic review demonstrated a reduction in the length of hospital stay and cancellation of surgery when the patients had been assessed in the PAC. There is a need for high-quality prospective studies to gain a deeper understanding of the effectiveness of PACs.

PROSPERO registration number: CRD42019137724

Keywords: pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic review

Strengths and limitations of this study

- An extensive database search was conducted with no limitations on outcomes and the type of pre-anaesthetic assessment clinic.
- Only randomised or non-randomised prospective controlled studies were included.
- The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.
- The included studies were heterogeneous and had a high risk of bias, which is a major limitation of this review.

INTRODUCTION

Anaesthesia is crucial in surgery. However, it may activate physiological changes that increase morbidity and mortality,[1] depending on the patients' preoperative health status and age.[2] Hospitals treat patients with complex, comorbid healthcare problems, undergoing progressively extensive surgeries and interventions.[3,4] To ensure the quality and safety of anaesthesia and surgery, precise knowledge of the clinical characteristics of patients is critical to the perioperative management.[2] Over the past 50 years, perioperative mortality, including anaesthesia-related mortality, has declined, which is significant in developed countries,[1,5] mainly because of new anaesthetics, improved monitoring equipment and training, availability of recovery rooms, and improved airway management.[4] However, a previous review found higher rates of morbidity and mortality in non-operating room anaesthesia, which was attributed to limited preoperative evaluation.[6] A retrospective study found significant associations between perioperative mortality and age < 1 year or > 65 years, American Society of Anesthesiologists Physical Status Classification System (ASA), emergency case status, and operative start time after

6:00 PM.[7] This might indicate that risk factors are both patient- and surgery-related and may be linked to organisational structures.[8]

Currently, an increasing number of pre-anaesthesia assessment clinics (PACs) support hospitals internationally in handling the rising number of patients and complexity of surgical procedures.[9] The design of PACs differs critically based on location, organisational structure, timing, and patient groups. They primarily function as a service unit for surgeons, patients, and the anaesthetic team.[10] The PAC consultation, by the anaesthesiologist, anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the patients' medical condition prior to surgery and anaesthesia.[2] Thus, it is essential for secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk patients, improves patient outcomes, prepares the patient physically and psychologically for anaesthesia, and ensures the patient's most favourable condition for surgery and anaesthesia.[11-13] This is primarily performed by interviewing and examining the patient; reviewing previous medical, surgical and anaesthesia issues; evaluating current medication; and obtaining and reviewing preoperative tests.[10] PACs also allow increased communication between healthcare providers and coordination with postoperative care.[14,15] Because of well-prepared patients and staff, several researchers have indicated that with PAC, the number of surgical cancellations, length of hospital stay, laboratory tests, and mortality rate have reduced.[7,16,17] Others assert that patients feel less anxious regarding the subsequent anaesthetic and surgical processes and are highly satisfied with the service with PAC consultations.[16,18,19]

As Turunen *et al.* stated, research on PACs regarding costs, financial savings, the impact on patient safety and quality of care, accuracy of the number of operative patients, and effect

on preoperative nursing levels, is scarce.[20] Survey results indicate that anaesthesiologists perceive day of surgery delays due to missing information as common, even with PAC consultations.[21] This systematic review aimed to examine the effectiveness of PACs in improving the quality and safety of perioperative patient care. Further, we aimed to determine the gaps in existing knowledge for future research.

METHODS

Our systematic review followed the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions[22] and was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[23] The protocol was registered in PROSPERO: CRD42019137724.[24]

The two review questions were:

1. Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?
2. Is PAC effective in reducing cancellation rate and cost of surgery, and improving the efficiency of perioperative patient care?

Search strategies

We performed a scoping search in different databases to identify the key terms.[25,26] The final search was planned and conducted in close collaboration with the university librarian. On 11 September 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) databases, which were updated on 3 February 2020 and 4 February 2021. Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words, such as ‘pre-anaesthesia’, ‘nurse’, ‘surgery’, ‘anaesthesia’, ‘preoperative’, ‘assessment’, ‘measurement’, ‘evaluate’, ‘preadmission’, ‘centre’, ‘clinic’, ‘ward’, ‘unit’, and ‘outpatient’. The searches are detailed in Appendix 1. The search mode in CINAHL was Boolean/Phase,

which supports Boolean searching or exact phrase searching. For comprehensiveness, we used both the truncation and proximity operators. We limited the search to 1996, the year one of the first known articles in this area was published.[27] Complementary methods to identify studies included following up on citations via Scopus, scanning the reference lists of relevant papers and included articles, and checking for relevant studies in clinical trials.[25]

Eligibility criteria

The main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English or Scandinavian language, (b) scientific publication of original research, (c) reported the outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-randomised prospective controlled studies, and (f) newly established PAC. The following were excluded: (a) editorials, discussions, and conference abstracts, (b) reviews, (c) instrument testing, (d) studies on children, and (e) retrospective studies.

Study selection

All references identified in the search were transferred to EndNoteX9, where the duplicates were removed. Subsequently, all unique references were transferred to the Covidence screening tool.[28] Study eligibility was ascertained independently, first at the title and abstract level, and subsequently at the full text level. Three of the authors screened all the articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were resolved by consulting two other authors (RCB and TOT).

Quality assessment

Risk of bias in studies were assessed using design-specific checklists. Given the methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.[29] Author EWK performed the risk of

bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through discussion with MF and AO. Each of the nine checklist questions was answered no, yes, unclear, or not applicable.

Data extraction and analysis

Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the authors confirmed the accuracy, consistency, and completeness of the extracted data that included publication details; study design; setting; and characteristics of the patients, interventions, comparisons, and outcome (PICO). We requested information on the missing data; however, received no response from the authors. If the PICO elements had been sufficiently similar and statistical data were available, we had intended to conduct a meta-analysis. However, the extracted data revealed substantial heterogeneity. Therefore, we performed a narrative synthesis. We described the findings in text, stratified by outcome, with descriptions of the effects of interventions for each study, classification of the effect direction, and we looked across contributing studies to develop a summary of findings for each outcome.[22]

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research. However, the project was initiated by health professionals.

RESULTS

Figure 1. provides the details of the study selection process. A total of 2,981 records were identified in the final search (2021). After removing duplicates, we screened 2,058 records

based on the title and abstract; 179 records passed the full-text screening. After applying the inclusion criteria, seven studies were selected for the final analysis.

Overall characteristics of the studies

The seven studies are listed in Table 1. All seven studies were in English and were published between 2000 and 2017, with data collected between 1997 and 2015 (one study did not report data collection information).[30] Based on the inclusion criteria, all were prospective controlled studies; however, no RCTs were found. There was one controlled before-after study.[31] The remaining six studies had control groups; assessments followed PAC implementation, without baseline assessments. There were three two-group non-parallel after-only studies,[32-34] and three two-group parallel after-only studies;[30] one had a matched control group[35] and one had three follow-up assessments of one arm.[36] One study had only cancellation rate as prospective data.[32] The studies included 77,411 patients.

Table 1: Description of the included studies

Author, Year, Country	Study design	Sampling time	Population	Intervention	Comparison	Outcomes
Farasatkish,2009[33] Iran	Two-group after study	May 2007 through August 2007	N=1716, open-heart surgery, ASA class III-IV	Pre-anaesthesia consultation clinic (3-10 days before surgery)	Usual care (within 24 h of surgery)	Cancellations
Kamal,2011[34] England	Two-group after study	April 2005 through April 2009	N=1445, complex elective orthopaedic surgery, ASA class III-IV	Preoperative anaesthetic assessment clinic (timing not stated)	Usual care (day of surgery)	Admissions, length of stay, mortality, cost
Kamau,2017[31] Kenya	CBA	August 2000, April 2001, November 2001	N=51, elective non-cardiac surgery, ASA class not stated	Pre-anaesthesia clinic consultation (≥48 h before surgery)	Usual care (day before surgery)	Anxiety (STAI score)
Klopfenstein,2000[30] Switzerland	Two-group after study (parallel)	No data	N=40, elective endoscopic urological surgery, ASA class I-III	Pre-anaesthetic consultation (1-2 weeks before surgery)	Usual care (the evening before surgery)	Anxiety (MAACL, VAS)
Lee,2012[35] China	Two-group after study (parallel)	March 2007 through November 2009	N=352, elective surgery, ASA class I-IV	Anaesthesia consultation clinic (≤3 months before surgery)	Usual care (the evening before surgery)	Quality of recovery score, cost, cancellations, length of stay, satisfaction, anxiety (VAS), willingness to pay (WTP)
Mendes,2005[36] Brazil	Two-group after study (parallel)	April 2007 through June 2007	N=52254, surgery, ASA class not stated	Preoperative outpatient evaluation clinic (timing not stated)	Usual care (timing not stated)	Cancellations, length of stay

van Klei,2002[32] The Netherlands	Two-group after study	November 2012	N=21553, elective surgery, ASA class not stated	Preoperative outpatient evaluation clinic (average 3 weeks before surgery)	Usual care (day before surgery)	Cancellations

ASA: American Society of Anesthesiology; CBA: controlled before-after; MAACL: Multiple Affect Adjective Check List; STAI: State-Trait Anxiety Inventory; VAS: visual analogue scale; WTP: willingness to pay

Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and control groups, respectively. One study did not specify the number of patients in the intervention and control groups, but only the total number of surgeries performed.[36] Five studies reported data for sex, showing that 51% of the patients were women and 49% were men (12,129 vs. 11,583).[30-33,35] There were more women than men in both the intervention (4,345 vs. 4,134) and control groups (7,784 vs. 7,449). Five studies reported data for age showing that all patients were over 20 years of age[30-33,35] and four studies had grouped within the American Society of Anesthesiology (ASA) category.[30,33-35]

The patients were scheduled to undergo a variety of surgeries, including orthopaedic,[31,32,34,35] urology,[30-32,35] general,[31,32,35] heart,[33] gynaecology/obstetrics,[31,32,35] vascular surgery,[32] ophthalmology,[32] maxillofacial/dental surgery,[31,32] and neurological surgery,[32] while one did not specify the type.[36] In five studies, the type of anaesthesia was not specified,[31-34,36] and two studies reported patients for general and/or regional supplement.[30,35]

The patients included had previous anaesthetic experience in one study,[30] previous and no previous anaesthetic experience in another,[31] and five studies did not report this data.[32-36] Limited background characteristics of the patients were reported in two studies.[34,36] One stated that the patients included had ASA 3 or 4 and a body mass index >40; however, no ASA number, sex, or age was reported.[34] Mendes *et al.* did not report any background characteristics of the included patients.[36]

Considering the intervention, the PACs in all studies comprised an outpatient service whereby patients were examined for medical conditions important for anaesthesia and informed regarding expectations on the day of surgery. Nevertheless, the terminology used for PACs varied, as they served different surgical specialities and conducted pre-anaesthesia consultation from ≥48 h to ≤3 months before the surgery. The settings included a university hospital (n=3),[31,35,36] teaching hospital (n=1),[32] medical centre (n=1),[33] and general hospital (n=1);[34] one study did not specify the context.[30] The staff conducting the pre-anaesthetic consultation also varied: in five studies, it was the anaesthesiologists,[30,32,34-36] in the other studies, it was (also) the orthopaedic senior house officer,[34] consultant or resident,[31] or physician.[33] In three studies, nurses were part of the team.[32,34,35] The comparison in all studies was usual care, which generally involved a preoperative anaesthetic evaluation of the admitted patients the day before the surgery.

Description of risk of bias in the studies

Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the cause and effect were clear. Most of the studies measured outcomes similarly and used appropriate statistical analyses. Several studies had limitations of follow-up and similarity in care and participants. None of the patients had multiple pre-and post-measurements.

Outcomes of the included studies

The outcomes of the included studies are each described separately below.

Satisfaction

One study reported satisfaction as an outcome.[35] The summarised patient satisfaction with the anaesthetic consultation score out of 100 showed that the patients in the PAC group were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%; p=0.01).[35] There was no statistically significant difference between the two groups

in mean patient satisfaction with perioperative anaesthesia care score after surgery (mean difference 0.01%, *p*=0.94).[35] The quality of recovery (QoR) measure referred to the patients' quality of recovery score.[37] The mean QoR score (range, 0–18) following anaesthesia on the first day after surgery was similar between the intervention (13.17±2.73) and control (13.31±2.65) groups (*p*=0.67).[35]

Anxiety

Three studies reported anxiety.[30,31,35] Two studies reported the visual analogue scale (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[30] another used a 100-mm horizontal line with 'not anxious at all' to 'extremely anxious'.[35] In one study, the median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control group (*p*=0.0038).[30] In another study, there were no significant differences between the control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively, *p*=0.12), and anaesthesia (20 vs. 19, respectively, *p*=0.60).[35] The median Multiple Affect Adjective Check List (MAACL) score, with possible range of scores from 0 to 21 (higher scores indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in the control group (*p*=0.0053).[30] The differences in the State-Trait Anxiety Index (STAI) score, which comprised 40 questions rated on a four-point Likert scale, was 1.51 (95% CI: 1.02–2.02%, *p*=0.0051).[31] The results on anxiety in these two studies were significant. However, Kamau *et al.* found no differences on examining anxiety and the influences of sex, duration of hospital stay, and prior anaesthesia experience.[31]

Mortality

One study reported the mortality rates.[34] Patients attending the High Dependency Unit (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex

orthopaedic surgery had a significant reduction in mortality rate after being assessed at the PAC, from 18 (6.1%) of 298 patients to 14 (1.2%) of 1147 patients (p=0.001).[34]

Cancellation rate

Four studies reported reduced cancellation rates following the establishment of a PAC.[32,33,35,36] One of the included studies had 316 (2.0%) cancellations for medical reasons before the introduction of PAC, and 79 (0.9%) after, with a difference of 1.02% (95% CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%).[32] The overall cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following PAC introduction, with a difference of 0.9% (95% CI, 0.3–1.0%).[32] Mendes *et al*.[36] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. In the first year of their study, there were 469 cancellations per 10,639 surgeries performed. The following year, a considerable increase above the baseline in the intervention group was observed, followed by a progressive decrease in the last year with 391 cancellations per 10,397 surgeries performed.[36] Farasatkish *et al.* reported that of the 1,716 patients studied, a mean of 15.1 % cancelled in the two groups. The cancellation rates in the control and intervention groups were 16.8% (146 [number of cancellations]/866 [number of surgeries]) and 13.29% (113/850) (p=0.046), respectively. The most common reason for cancellation was incomplete medical work-up; 51/146 (35%) in the control group and 32/113 (28%) in the intervention group (p=0.03).[33] Lee *et al.* found similar rates for surgery being cancelled on the scheduled date for the intervention group compared with the control group (2.3% vs. 3.4%, p=0.75).[35]

Costs and willingness to pay

Two studies reported the costs.[34,35] One study reported a total saving of £ 486.62 per patient after establishing a PAC.[34] Another reported a significantly lower preoperative cost per patient in the intervention group compared with that of the control group (mean difference, $ 463; 95% CI, -$648 to -$278 per patient, $p<0.01$).[35] However, the mean difference in the total perioperative treatment cost was not significant, even after adjusting for cancellation on the day of surgery costs.[35] Compared to the control group, the willingness to pay (WTP) among the intervention group patients was significantly more than the median WTP (US $13) for a clinic consultation at the PAC.[35]

Length of stay

The length of stay was reported in three studies.[34-36] Mendes *et al*.[36] found a significant decrease in mean hospital stay of patients from 6.2 to 5.0 days ($p \leq 0.001$) during the 4 years of this study. Kamal *et al.*[34] found a significant reduction in the length of stay in the HDU from 2.1 days to 1.6 days ($p=0.01$), and in the ICU from 2.3 days to 1.9 days ($p=0.01$). In the last study, no significant changes were found in the median duration of postoperative stay between the intervention and control groups.[35]

Organisation planning and efficiency

Organisation planning and efficiency have been reported in two studies.[34,36] One study found statistically significant changes in the reduction of unplanned admissions to the PACU (65/298 [22%], 111/1147 [10%], $p=0.001$), ICU (4/298 [1.3%], 4/1147 [0.4%], $p=0.01$), and HDU (4/298 [1.34%], 20/1147 [1.7%], $p=0.01$) after implementing a PAC.[34] The planned admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p=0.01$), and HDU (14/298 [4.7%], 85/1147 [7.4%], $p=0.1$) increased after implementing a PAC.[34] The number of PAC evaluations increased from 14,704 (year 1) to 413,990 (year 4) ($p\leq 0.001$).[36] The number

of outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$) and the inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4) ($p \leq 0.001$).[36]

DISCUSSION

This systematic review summarises the effectiveness of PACs in improving quality and safety of pre-anaesthetic patient care in general hospitals and determines the gaps in existing knowledge for future research. Herein, we present the main results of the review and infer the implications for research and practice.

Seven studies met the inclusion criteria, and the main findings were reduction in the length of stay and surgery cancellation rate in hospitals. However, the studies were of low quality, making it difficult to draw any conclusion. The evidence from our systematic review is insufficient to conclude whether patients have reduced anxiety because of PAC. This is because the included studies used different instruments for measuring anxiety levels, and the results could not be pooled.[38]

A major purpose of establishing a PAC in a hospital is to better prepare the patients for the anticipated surgery. Healthcare professionals and policymakers are exploring strategies to reduce unnecessary investigations without compromising quality of care and patient safety.[39] Transition of evidence-based interventions to the hospital systems can provide substantial benefits to patient care.[40] According to the ASA and the National Institute of Health and Care Excellence, routine preoperative laboratory tests are not recommended for relatively healthy patients. Instead, they encourage patient and surgery- specific investigations.[15,40] This recommendation is not always implemented in hospital protocols

or practice. An observational study showed that routine preoperative testing to predict abnormalities found at least one abnormal test result in most of the relatively healthy patients. Only 0.67% of the abnormalities had a significant impact on changing the perioperative management.[41] Blitz *et al.* argued that PACs should focus on early patient engagement strategies, interdisciplinary team communication, detailed perioperative care plans, and patient documentation using electronic health record, which should be open for review by the perioperative team.[14] Furthermore, a previous study mentioned that the risk factors are not only patient-related but also organisation-related,[7] and that some hospitals have perioperative care teams that are better at identifying and relieving perioperative complications.[42,43] Thus, the value of PACs lies in their ability to improve the quality of the perioperative process by designing a more robust system for preoperative assessment and preparation.[14] A narrative review found higher rates of morbidity and mortality in non-operating room anaesthesia, and one of the main reasons was limited preoperative evaluation.[6] In this systematic review, the assessment of PAC was significantly associated with reduced mortality following complex orthopaedic surgery in only one study.[34] Retrospective studies have reported similar results, but with different surgeries.[14,44]

Cancellation on the day of surgery has undesirable effects on both the patients and the hospital system.[13] Late patient-related cancellations can totally or partially be prevented,[45] if addressed during preoperative evaluations.[16] This has been confirmed by only three studies in this systematic review that found a reduction in surgery cancellation after implementing a PAC.[32,33,36] However, Lee *et al.* found no significant changes between the intervention and control groups.[35] Mendes *et al.* found that the number of

cancellations for medical reasons after PAC implementation decreased in the first year of implementation. In the second and third years, they were high before the number dropped to below baseline.[36] These conflicting findings indicate that hospitals operate in specific contexts, with unique populations, processes, and microsystems, encountering unique obstacles, making implementation difficult. Patient-focused interventions should consider barriers, facilitators, and interrelationships between systems, staff, and interventions to increase the likelihood of sustainable success.[46] Additionally, Kamal *et al.* indicated that PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more predictable for patients, staff, and administration.[34]

Another finding of this review was a significant reduction in the length of hospital stay following patients' examination in a PAC; however, a small number of studies with low quality were considered. Nevertheless, similar results were found in another systematic review claiming that perioperative systems support the hospitals by addressing the expected growth in the number and complexity of surgical procedures.[16] When patients are examined in the PAC and well-prepared with information, consultations, and tests, they need not be hospitalised until the day of surgery. A survey on operated patients showed that given a choice, 75% do not wish admission to the hospital until the day of operation; a major reason being shorter hospital stay.[47] An updated systematic review on the effectiveness of nurse-led preoperative assessment services for elective surgery found that the included articles demonstrated a reduced length of stay; these studies had low methodological quality, and therefore, the authors could not conclude that this service leads to reduced length of hospital stay.[17]

Strengths and limitations of the study

The review was performed in duplicate or independently by two researchers, and consensus was reached through discussion. However, grey literature, such as government and institutional documents, was excluded and might be a limitation of this study. Since organisation of healthcare systems varies among countries, the type of staff who performed the preoperative assessment was not considered as an inclusion criterion. The European Society of Anaesthesiology guidelines recommend that the anaesthesiologists must complete the preoperative assessment while trained nurses or anaesthesia trainees should perform the screening.[8] A preoperative evaluation performed by an internist was associated with increased length of stay and increased postoperative mortality.[48] The results of this systematic review may have been affected by the heterogeneity in the types of staff performing the preoperative assessment.

We exclusively included studies with high internal validity. Therefore, several retrospective studies were excluded. Nonetheless, as the remaining studies´ risk of bias was fairly high, and they were heterogeneous, a meta-analysis was not statistically appropriate.[26] The included studies' designs could not rule out selection bias and confounders; thus, the strength of the evidence should be assessed cautiously. Many studies did not adjust for several confounders, which could be responsible for the observed effects. Several studies lacked descriptions of the methods used and the patients included, lowering transparency. The results are relevant to health care services, focusing on the well-being and safety of the patients.

Implications for future research and practice

This systematic review identified the ambiguity in the PAC interventions offered to the intervention group. In many studies, it was evident that the methods used lacked clarity, and high-quality research is needed in this field. The included studies did not demonstrate earlier surgical room entry time[49,50] or reduction in the number of preoperative tests for patients attending the PAC, similar to the results of the retrospective studies.[27] Other implications may include the organisation structure of different PACs and their functioning. Additionally, the tests that should be part of the assessment at the PACs should be investigated. The use of technology, such as streaming services, facilitates different patient groups and might become crucial for reducing human contact and spread of infection in context of coronavirus disease 2019.

CONCLUSION

PAC use has reduced the length of stay and surgery cancellation rate at hospitals. However, the effectiveness of PAC, the major review question, remains unclear, and requires further research. There is a demand for high-quality studies capturing robust data describing the quality of care and clinical outcomes for patients requiring anaesthesia. This requires increased focus and funding for this specific area of health services research and could, therefore, lead to implementation of PACs in health care services and improve patient safety and perioperative care.

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Competing Interests

The authors declare that they have no conflict of interest.

Data sharing statement

All data relevant to the study are included within the article or have been uploaded within supplemental files.

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Author contributions

EWK, MF, AO, and TOT: Study design

EWK, MF, AO: Search and screening of the articles

EWK: Data extraction

MF, AO, RCB, and TOT: Control of data extraction

EWK, MF, AO, and RCB: Quality assessment of the included articles

EWK: Drafting of the manuscript

MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript

MF, AO, RCB, and TOT: Supervised the study

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Figure legends

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [23]

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [29]

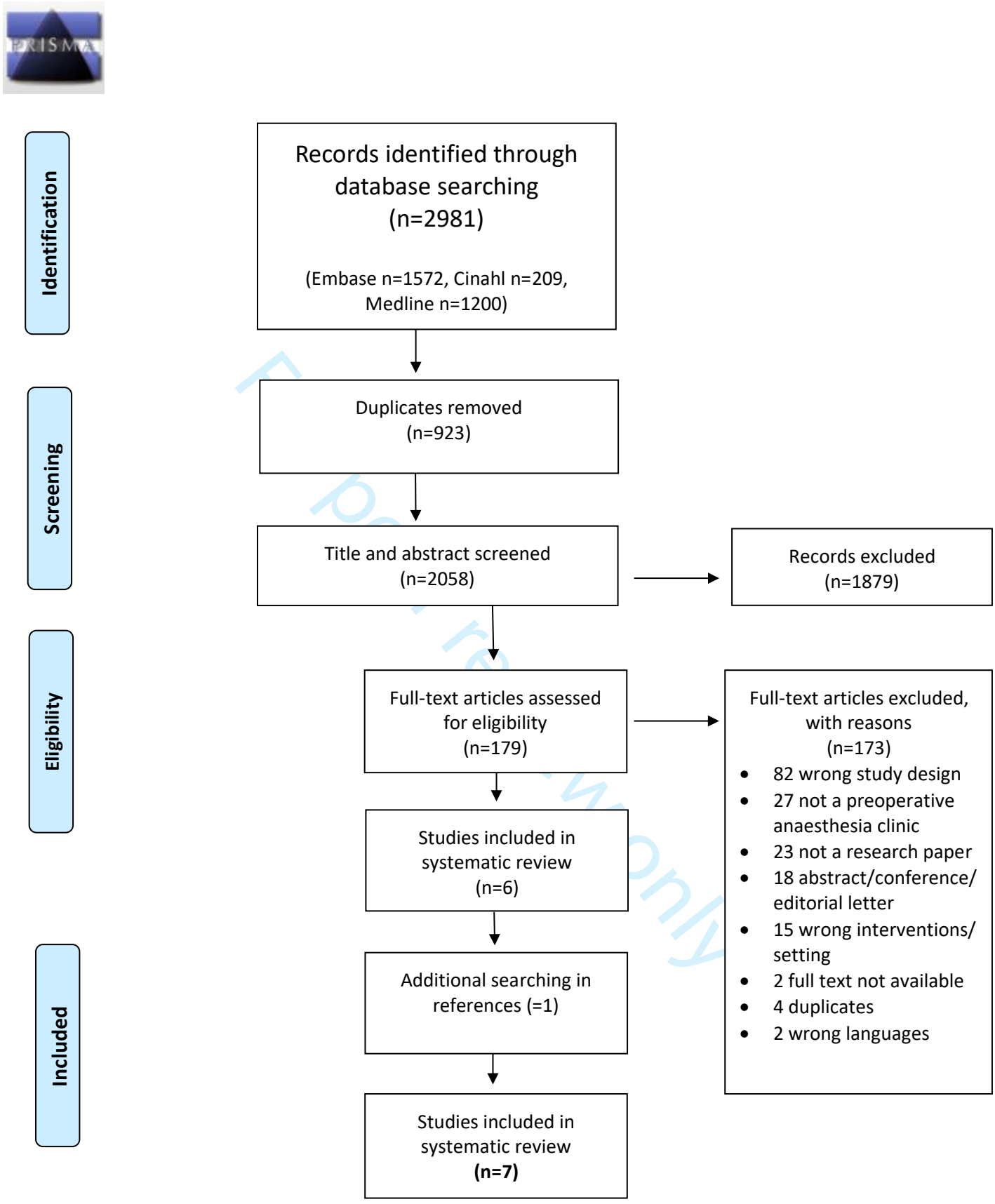

Figure 1: Prefferd Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [24]

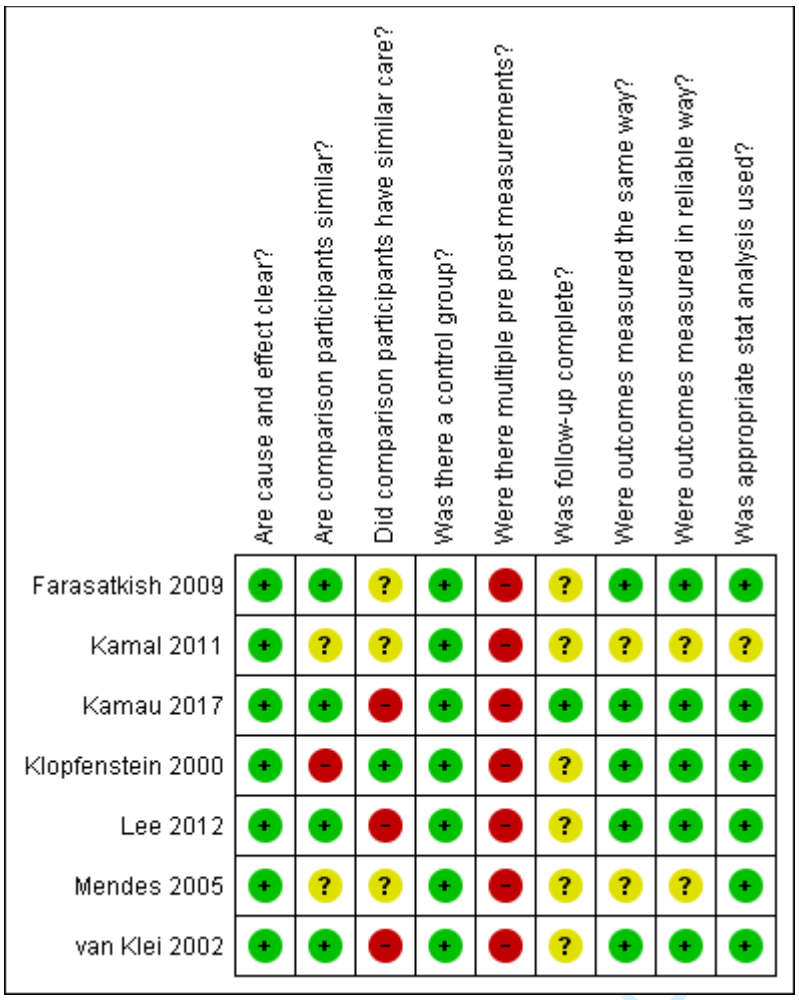

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [30]

Appendix 1: Search strategies

Table of Content

1. Database Search Strategies

The search mode for CINAHL was Boolean/Phrase. For those searches that are done without search fields - it is automatically searched in the standard fields that CINAHL uses, including words from title, summary, and subject headings.
Search 1 and Search 2 are with words in the title (TI in front of the keywords), however this have not been done with the other searches.

Embase and Medline have the same search mode because we are searching for words from title, summary, and subject headings.

2. Initial searches, 11 September 2018

2.1. Main Databases

Database: Embase, (Ovid)

Results: n=1287
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab. (689)
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=997
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 remove duplicates from 9

Database: Cinahl Plus with Full Text (EBSCOhost)

Results: n=132
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-20181231; Exclude MEDLINE records

3. Search update, 3 February 2020

3.1. Main Databases

Database: Embase (Ovid)

Results: n=1453
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1105
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=166
Search:
1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
7 S3 OR S4 OR S5 OR S6 OR S7 487
8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

4. Search update, 4 February 2021

4.1. Main Databases

Database: Embase (Ovid)

Results: n=1572
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1200
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.

5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab. (4)
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=209
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

Reporting checklist for systematic review and meta-analysis.

Based on the PRISMA guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMAreporting guidelines, and cite them as:

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement

		Reporting Item	Page Number
Title			
	#1	Identify the report as a systematic review, meta-analysis, or both.	1
Abstract			
Structured summary	#2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	2
Introduction			
Rationale	#3	Describe the rationale for the review in the context of what is already known.	3-5

Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
Methods			
Protocol and registration	#5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address) and, if available, provide registration information including the registration number.	5
Eligibility criteria	#6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rational	6
Information sources	#7	Describe all information sources in the search (e.g., databases with dates of coverage, contact with study authors to identify additional studies) and date last searched.	5,6
Search	#8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5,6 + APPENDIX 1
Study selection	#9	State the process for selecting studies (i.e., for screening, for determining eligibility, for inclusion in the systematic review, and, if applicable, for inclusion in the meta-analysis).	6
Data collection process	#10	Describe the method of data extraction from reports (e.g., piloted forms, independently by two reviewers) and any processes for obtaining and confirming data from investigators.	6-7
Data items	#11	List and define all variables for which data were sought (e.g., PICOS, funding sources), and any assumptions and simplifications made.	5-7
Risk of bias in individual studies	#12	Describe methods used for assessing risk of bias in individual studies (including specification of whether this was done at the study or outcome level, or both), and how this information is to be used in any data synthesis.	6-7

Summary measures	#13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Planned methods of analyis	#14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis.	7
Risk of bias across studies	#15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	12
Additional analyses	#16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
Results			
Study selection	#17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8 + Figure
Study characteristics	#18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citation.	N/A
Risk of bias within studies	#19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	12 + Figure
Results of individual studies	#20	For all outcomes considered (benefits and harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	12-16
Synthesis of results	#21	Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency.	11-16
Risk of bias across studies	#22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	#23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
Discussion			

Summary of Evidence	#24	Summarize the main findings, including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers	16-19
Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	19
Conclusions	#26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20
Funding			
Funding	#27	Describe sources of funding or other support (e.g., supply of data) for the systematic review; role of funders for the systematic review.	21

BMJ Open

Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and non-randomised prospective controlled studies

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Keywords:	Adult anaesthesia < ANAESTHETICS, Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Adult surgery < SURGERY

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Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and non-randomised prospective controlled studies

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ABSTRACT

Objectives: The aim of this systematic review was to examine the effectiveness of pre-anaesthesia assessment clinics (PACs) in improving the quality and safety of perioperative patient care.

Design: Systematic review.

Data sources: The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) were systematically searched on 11 September 2018 and updated on 3 February 2020 and 4 February 2021.

Eligibility criteria: The inclusion criteria for this study were studies published in English or Scandinavian language and scientific original research that included randomised or non-randomised prospective controlled studies. Additionally, studies that reported the outcomes from a PAC consultation with the patient present were included.

Data extraction and synthesis: Titles, abstracts, and full texts were screened by a team of three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal checklist for quasi-experimental studies. Data extraction was performed by one author and checked by four other authors. Results were synthesised narratively owing to the heterogeneity of the included studies.

Results: Seven prospective controlled studies on the effectiveness of PACs, were included. Three studies reported a significant reduction in the length of hospital stay and two studies reported a significant reduction in cancellation of surgery for medical reasons when patients were seen in the PAC. In addition, the included studies presented mixed results regarding anxiety in patients. Most studies had a high risk of bias.

Conclusion: This systematic review demonstrated a reduction in the length of hospital stay and cancellation of surgery when the patients had been assessed in the PAC. There is a need for high-quality prospective studies to gain a deeper understanding of the effectiveness of PACs.

PROSPERO registration number: CRD42019137724

Keywords: pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic review

Strengths and limitations of this study

- An extensive database search was conducted with no limitations on outcomes and the type of pre-anaesthetic assessment clinic.
- Only randomised or non-randomised prospective controlled studies were included.
- The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.
- The included studies were heterogeneous and had a high risk of bias, which is a major limitation of this review.

INTRODUCTION

Anaesthesia is crucial in surgery. However, it may activate physiological changes that increase morbidity and mortality,[1] depending on the patients' preoperative health status and age.[2] Hospitals treat patients with complex, comorbid healthcare problems, undergoing progressively extensive surgeries and interventions.[3,4] To ensure the quality and safety of anaesthesia and surgery, precise knowledge of the clinical characteristics of patients is critical to the perioperative management.[2] Over the past 50 years, perioperative mortality, including anaesthesia-related mortality, has declined, which is significant in developed countries,[1,5] mainly because of new anaesthetics, improved monitoring equipment and training, availability of recovery rooms, and improved airway management.[4] However, a previous review found higher rates of morbidity and mortality in non-operating room anaesthesia, which was attributed to limited preoperative evaluation.[6] A retrospective study found significant associations between perioperative mortality and age < 1 year or > 65 years, American Society of Anesthesiologists Physical Status Classification System (ASA), emergency case status, and operative start time after

6:00 PM.[7] This might indicate that risk factors are both patient- and surgery-related and may be linked to organisational structures.[8]

Currently, an increasing number of pre-anaesthesia assessment clinics (PACs) support hospitals internationally in handling the rising number of patients and complexity of surgical procedures.[9] The design of PACs differs critically based on location, organisational structure, timing, and patient groups. They primarily function as a service unit for surgeons, patients, and the anaesthetic team.[10] The PAC consultation, by the anaesthesiologist, anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the patients' medical condition prior to surgery and anaesthesia.[2] Thus, it is essential for secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk patients, improves patient outcomes, prepares the patient physically and psychologically for anaesthesia, and ensures the patient's most favourable condition for surgery and anaesthesia.[11-13] This is primarily performed by interviewing and examining the patient; reviewing previous medical, surgical and anaesthesia issues; evaluating current medication; and obtaining and reviewing preoperative tests.[10] PACs also allow increased communication between healthcare providers and coordination with postoperative care.[14,15] Because of well-prepared patients and staff, several researchers have indicated that with PAC, the number of surgical cancellations, length of hospital stay, laboratory tests, and mortality rate have reduced.[7,16,17] Others assert that patients feel less anxious regarding the subsequent anaesthetic and surgical processes and are highly satisfied with the service with PAC consultations.[16,18,19]

As Turunen *et al.* stated, research on PACs regarding costs, financial savings, the impact on patient safety and quality of care, accuracy of the number of operative patients, and effect

on preoperative nursing levels, is scarce.[20] Survey results indicate that anaesthesiologists perceive day of surgery delays due to missing information as common, even with PAC consultations.[21] This systematic review aimed to examine the effectiveness of PACs in improving the quality and safety of perioperative patient care. Further, we aimed to determine the gaps in existing knowledge for future research.

METHODS

Our systematic review followed the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions[22] and was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[23] The protocol was registered in PROSPERO: CRD42019137724.[24]

The two review questions were:

1. Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?
2. Is PAC effective in reducing cancellation rate and cost of surgery, and improving the efficiency of perioperative patient care?

Search strategies

We performed a scoping search in different databases to identify the key terms.[25,26] The final search was planned and conducted in close collaboration with the university librarian. On 11 September 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and Embase (OvidSP) databases, which were updated on 3 February 2020 and 4 February 2021. Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words, such as ‘pre-anaesthesia’, ‘nurse’, ‘surgery’, ‘anaesthesia’, ‘preoperative’, ‘assessment’, ‘measurement’, ‘evaluate’, ‘preadmission’, ‘centre’, ‘clinic’, ‘ward’, ‘unit’, and ‘outpatient’. The searches are detailed in Appendix 1. The search mode in CINAHL was Boolean/Phase,

which supports Boolean searching or exact phrase searching. For comprehensiveness, we used both the truncation and proximity operators. We limited the search to 1996, the year one of the first known articles in this area was published.[27] Complementary methods to identify studies included following up on citations via Scopus, scanning the reference lists of relevant papers and included articles, and checking for relevant studies in clinical trials.[25]

Eligibility criteria

The main inclusion criterion was that the study, using empirical quantitative methods, addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English or Scandinavian language, (b) scientific publication of original research, (c) reported the outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-randomised prospective controlled studies, and (f) newly established PAC. The following were excluded: (a) editorials, discussions, and conference abstracts, (b) reviews, (c) instrument testing, (d) studies on children, and (e) retrospective studies.

Study selection

All references identified in the search were transferred to EndNoteX9, where the duplicates were removed. Subsequently, all unique references were transferred to the Covidence screening tool.[28] Study eligibility was ascertained independently, first at the title and abstract level, and subsequently at the full text level. Three of the authors screened all the articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were resolved by consulting two other authors (RCB and TOT).

Quality assessment

Risk of bias in studies were assessed using design-specific checklists. Given the methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used.[29] Author EWK performed the risk of

bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through discussion with MF and AO. Each of the nine checklist questions was answered no, yes, unclear, or not applicable.

Data extraction and analysis

Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the authors confirmed the accuracy, consistency, and completeness of the extracted data that included publication details; study design; setting; and characteristics of the patients, interventions, comparisons, and outcome (PICO). We requested information on the missing data; however, received no response from the authors. If the PICO elements had been sufficiently similar and statistical data were available, we had intended to conduct a meta-analysis. However, the extracted data revealed substantial heterogeneity. Therefore, we performed a narrative synthesis. We described the findings in text, stratified by outcome, with descriptions of the effects of interventions for each study, classification of the effect direction, and we looked across contributing studies to develop a summary of findings for each outcome.[22]

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research. However, the project was initiated by health professionals.

RESULTS

Figure 1. provides the details of the study selection process. A total of 2,981 records were identified in the final search (2021). After removing duplicates, we screened 2,058 records

based on the title and abstract; 179 records passed the full-text screening. After applying the inclusion criteria, seven studies were selected for the final analysis.

Overall characteristics of the studies

The seven studies are listed in Table 1. All seven studies were in English and were published between 2000 and 2017, with data collected between 1997 and 2015 (one study did not report data collection information).[30] Based on the inclusion criteria, all were prospective controlled studies; however, no RCTs were found. There was one controlled before-after study.[31] The remaining six studies had control groups; assessments followed PAC implementation, without baseline assessments. There were three two-group non-parallel after-only studies,[32-34] and three two-group parallel after-only studies;[30] one had a matched control group[35] and one had three follow-up assessments of one arm.[36] One study had only cancellation rate as prospective data.[32] The studies included 77,411 patients.

Table 1: Description of the included studies

Author, Year, Country	Study design	Sampling time	Population	Intervention	Comparison	Outcomes
Farasatkish,2009[33] Iran	Two-group after study	May 2007 through August 2007	N=1716, open-heart surgery, ASA class III-IV	Pre-anaesthesia consultation clinic (3-10 days before surgery)	Usual care (within 24 h of surgery)	Cancellations
Kamal,2011[34] England	Two-group after study	April 2005 through April 2009	N=1445, complex elective orthopaedic surgery, ASA class III-IV	Preoperative anaesthetic assessment clinic (timing not stated)	Usual care (day of surgery)	Admissions, length of stay, mortality, cost
Kamau,2017[31] Kenya	CBA	August 2000, April 2001, November 2001	N=51, elective non-cardiac surgery, ASA class not stated	Pre-anaesthesia clinic consultation (≥48 h before surgery)	Usual care (day before surgery)	Anxiety (STAI score)
Klopfenstein,2000[30] Switzerland	Two-group after study (parallel)	No data	N=40, elective endoscopic urological surgery, ASA class I-III	Pre-anaesthetic consultation (1-2 weeks before surgery)	Usual care (the evening before surgery)	Anxiety (MAACL, VAS)
Lee,2012[35] China	Two-group after study (parallel)	March 2007 through November 2009	N=352, elective surgery, ASA class I-IV	Anaesthesia consultation clinic (≤3 months before surgery)	Usual care (the evening before surgery)	Quality of recovery score, cost, cancellations, length of stay, satisfaction, anxiety (VAS), willingness to pay (WTP)
Mendes,2005[36] Brazil	Two-group after study (parallel)	April 2007 through June 2007	N=52254, surgery, ASA class not stated	Preoperative outpatient evaluation clinic (timing not stated)	Usual care (timing not stated)	Cancellations, length of stay

van Klei,2002[32] The Netherlands	Two-group after study	November 2012	N=21553, elective surgery, ASA class not stated	Preoperative outpatient evaluation clinic (average 3 weeks before surgery)	Usual care (day before surgery)	Cancellations

ASA: American Society of Anesthesiology; CBA: controlled before-after; MAACL: Multiple Affect Adjective Check List; STAI: State-Trait Anxiety Inventory; VAS: visual analogue scale; WTP: willingness to pay

Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and control groups, respectively. One study did not specify the number of patients in the intervention and control groups, but only the total number of surgeries performed.[36] Five studies reported data for sex, showing that 51% of the patients were women and 49% were men (12,129 vs. 11,583).[30-33,35] There were more women than men in both the intervention (4,345 vs. 4,134) and control groups (7,784 vs. 7,449). Five studies reported data for age showing that all patients were over 20 years of age[30-33,35] and four studies had grouped within the American Society of Anesthesiology (ASA) category.[30,33-35]

The patients were scheduled to undergo a variety of surgeries, including orthopaedic,[31,32,34,35] urology,[30-32,35] general,[31,32,35] heart,[33] gynaecology/obstetrics,[31,32,35] vascular surgery,[32] ophthalmology,[32] maxillofacial/dental surgery,[31,32] and neurological surgery,[32] while one did not specify the type.[36] In five studies, the type of anaesthesia was not specified,[31-34,36] and two studies reported patients for general and/or regional supplement.[30,35]

The patients included had previous anaesthetic experience in one study,[30] previous and no previous anaesthetic experience in another,[31] and five studies did not report this data.[32-36] Limited background characteristics of the patients were reported in two studies.[34,36] One stated that the patients included had ASA 3 or 4 and a body mass index >40; however, no ASA number, sex, or age was reported.[34] Mendes *et al.* did not report any background characteristics of the included patients.[36]

Considering the intervention, the PACs in all studies comprised an outpatient service whereby patients were examined for medical conditions important for anaesthesia and informed regarding expectations on the day of surgery. Nevertheless, the terminology used for PACs varied, as they served different surgical specialities and conducted pre-anaesthesia consultation from ≥48 h to ≤3 months before the surgery. The settings included a university hospital (n=3),[31,35,36] teaching hospital (n=1),[32] medical centre (n=1),[33] and general hospital (n=1);[34] one study did not specify the context.[30] The staff conducting the pre-anaesthetic consultation also varied: in five studies, it was the anaesthesiologists,[30,32,34-36] in the other studies, it was (also) the orthopaedic senior house officer,[34] consultant or resident,[31] or physician.[33] In three studies, nurses were part of the team.[32,34,35] The comparison in all studies was usual care, which generally involved a preoperative anaesthetic evaluation of the admitted patients the day before the surgery.

Description of risk of bias in the studies

Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the cause and effect were clear. Most of the studies measured outcomes similarly and used appropriate statistical analyses. Several studies had limitations of follow-up and similarity in care and participants. None of the patients had multiple pre-and post-measurements.

Outcomes of the included studies

The outcomes of the included studies are each described separately below.

Satisfaction

One study reported satisfaction as an outcome.[35] The summarised patient satisfaction with the anaesthetic consultation score out of 100 showed that the patients in the PAC group were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%; p=0.01).[35] There was no statistically significant difference between the two groups

in mean patient satisfaction with perioperative anaesthesia care score after surgery (mean difference 0.01%, *p*=0.94).[35] The quality of recovery (QoR) measure referred to the patients' quality of recovery score.[37] The mean QoR score (range, 0–18) following anaesthesia on the first day after surgery was similar between the intervention (13.17±2.73) and control (13.31±2.65) groups (*p*=0.67).[35]

Anxiety

Three studies reported anxiety.[30,31,35] Two studies reported the visual analogue scale (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[30] another used a 100-mm horizontal line with 'not anxious at all' to 'extremely anxious'.[35] In one study, the median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control group (*p*=0.0038).[30] In another study, there were no significant differences between the control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively, *p*=0.12), and anaesthesia (20 vs. 19, respectively, *p*=0.60).[35] The median Multiple Affect Adjective Check List (MAACL) score, with possible range of scores from 0 to 21 (higher scores indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in the control group (*p*=0.0053).[30] The differences in the State-Trait Anxiety Index (STAI) score, which comprised 40 questions rated on a four-point Likert scale, was 1.51 (95% CI: 1.02–2.02%, *p*=0.0051).[31] The results on anxiety in these two studies were significant. However, Kamau *et al.* found no differences on examining anxiety and the influences of sex, duration of hospital stay, and prior anaesthesia experience.[31]

Mortality

One study reported the mortality rates.[34] Patients attending the High Dependency Unit (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex

orthopaedic surgery had a significant reduction in mortality rate after being assessed at the PAC, from 18 (6.1%) of 298 patients to 14 (1.2%) of 1147 patients (p=0.001).[34]

Cancellation rate

Four studies reported reduced cancellation rates following the establishment of a PAC.[32,33,35,36] One of the included studies had 316 (2.0%) cancellations for medical reasons before the introduction of PAC, and 79 (0.9%) after, with a difference of 1.02% (95% CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%).[32] The overall cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following PAC introduction, with a difference of 0.9% (95% CI, 0.3–1.0%).[32] Mendes *et al*.[36] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. In the first year of their study, there were 469 cancellations per 10,639 surgeries performed. The following year, a considerable increase above the baseline in the intervention group was observed, followed by a progressive decrease in the last year with 391 cancellations per 10,397 surgeries performed.[36] Farasatkish *et al.* reported that of the 1,716 patients studied, a mean of 15.1 % cancelled in the two groups. The cancellation rates in the control and intervention groups were 16.8% (146 [number of cancellations]/866 [number of surgeries]) and 13.29% (113/850) (p=0.046), respectively. The most common reason for cancellation was incomplete medical work-up; 51/146 (35%) in the control group and 32/113 (28%) in the intervention group (p=0.03).[33] Lee *et al.* found similar rates for surgery being cancelled on the scheduled date for the intervention group compared with the control group (2.3% vs. 3.4%, p=0.75).[35]

Costs and willingness to pay

Two studies reported the costs.[34,35] One study reported a total saving of £ 486.62 per patient after establishing a PAC.[34] Another reported a significantly lower preoperative cost per patient in the intervention group compared with that of the control group (mean difference, $ 463; 95% CI, -$648 to -$278 per patient, *p*<0.01).[35] However, the mean difference in the total perioperative treatment cost was not significant, even after adjusting for cancellation on the day of surgery costs.[35] Compared to the control group, the willingness to pay (WTP) among the intervention group patients was significantly more than the median WTP (US $13) for a clinic consultation at the PAC.[35]

Length of stay

The length of stay was reported in three studies.[34-36] Mendes *et al*.[36] found a significant decrease in mean hospital stay of patients from 6.2 to 5.0 days (p ≤ 0.001) during the 4 years of this study. Kamal *et al.*[34] found a significant reduction in the length of stay in the HDU from 2.1 days to 1.6 days (*p*=0.01), and in the ICU from 2.3 days to 1.9 days (*p*=0.01). In the last study, no significant changes were found in the median duration of postoperative stay between the intervention and control groups.[35]

Organisation planning and efficiency

Organisation planning and efficiency have been reported in two studies.[34,36] One study found statistically significant changes in the reduction of unplanned admissions to the PACU (65/298 [22%], 111/1147 [10%], *p*=0.001), ICU (4/298 [1.3%], 4/1147 [0.4%], *p*=0.01), and HDU (4/298 [1.34%], 20/1147 [1.7%], *p*=0.01) after implementing a PAC.[34] The planned admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], *p*=0.01), and HDU (14/298 [4.7%], 85/1147 [7.4%], *p*=0.1) increased after implementing a PAC.[34] The number of PAC evaluations increased from 14,704 (year 1) to 413,990 (year 4) (*p*≤ 0.001).[36] The number

of outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$) and the inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4) ($p \leq 0.001$).[36]

DISCUSSION

This systematic review summarises the effectiveness of PACs in improving quality and safety of pre-anaesthetic patient care in general hospitals and determines the gaps in existing knowledge for future research. Herein, we present the main results of the review and infer the implications for research and practice.

Seven studies met the inclusion criteria, and the main findings were reduction in the length of stay and surgery cancellation rate in hospitals. However, the studies were of low quality, making it difficult to draw any conclusion. The evidence from our systematic review is insufficient to conclude whether patients have reduced anxiety because of PAC. This is because the included studies used different instruments for measuring anxiety levels, and the results could not be pooled.[38]

A major purpose of establishing a PAC in a hospital is to better prepare the patients for the anticipated surgery. Healthcare professionals and policymakers are exploring strategies to reduce unnecessary investigations without compromising quality of care and patient safety.[39] Transition of evidence-based interventions to the hospital systems can provide substantial benefits to patient care.[40] According to the ASA and the National Institute of Health and Care Excellence, routine preoperative laboratory tests are not recommended for relatively healthy patients. Instead, they encourage patient and surgery- specific investigations.[15,40] This recommendation is not always implemented in hospital protocols

or practice. An observational study showed that routine preoperative testing to predict abnormalities found at least one abnormal test result in most of the relatively healthy patients. Only 0.67% of the abnormalities had a significant impact on changing the perioperative management.[41] Blitz *et al.* argued that PACs should focus on early patient engagement strategies, interdisciplinary team communication, detailed perioperative care plans, and patient documentation using electronic health record, which should be open for review by the perioperative team.[14] Furthermore, a previous study mentioned that the risk factors are not only patient-related but also organisation-related,[7] and that some hospitals have perioperative care teams that are better at identifying and relieving perioperative complications.[42,43] Thus, the value of PACs lies in their ability to improve the quality of the perioperative process by designing a more robust system for preoperative assessment and preparation.[14] A narrative review found higher rates of morbidity and mortality in non-operating room anaesthesia, and one of the main reasons was limited preoperative evaluation.[6] In this systematic review, the assessment of PAC was significantly associated with reduced mortality following complex orthopaedic surgery in only one study.[34] Retrospective studies have reported similar results, but with different surgeries.[14,44]

Cancellation on the day of surgery has undesirable effects on both the patients and the hospital system.[13] Late patient-related cancellations can totally or partially be prevented,[45] if addressed during preoperative evaluations.[16] This has been confirmed by only three studies in this systematic review that found a reduction in surgery cancellation after implementing a PAC.[32,33,36] However, Lee *et al.* found no significant changes between the intervention and control groups.[35] Mendes *et al.* found that the number of

cancellations for medical reasons after PAC implementation decreased in the first year of implementation. In the second and third years, they were high before the number dropped to below baseline.[36] These conflicting findings indicate that hospitals operate in specific contexts, with unique populations, processes, and microsystems, encountering unique obstacles, making implementation difficult. Patient-focused interventions should consider barriers, facilitators, and interrelationships between systems, staff, and interventions to increase the likelihood of sustainable success.[46] Additionally, Kamal *et al.* indicated that PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more predictable for patients, staff, and administration.[34]

Another finding of this review was a significant reduction in the length of hospital stay following patients' examination in a PAC; however, a small number of studies with low quality were considered. Nevertheless, similar results were found in another systematic review claiming that perioperative systems support the hospitals by addressing the expected growth in the number and complexity of surgical procedures.[16] When patients are examined in the PAC and well-prepared with information, consultations, and tests, they need not be hospitalised until the day of surgery. A survey on operated patients showed that given a choice, 75% do not wish admission to the hospital until the day of operation; a major reason being shorter hospital stay.[47] An updated systematic review on the effectiveness of nurse-led preoperative assessment services for elective surgery found that the included articles demonstrated a reduced length of stay; these studies had low methodological quality, and therefore, the authors could not conclude that this service leads to reduced length of hospital stay.[17]

Strengths and limitations of the study

The review was performed in duplicate or independently by two researchers, and consensus was reached through discussion. However, grey literature, such as government and institutional documents, was excluded and might be a limitation of this study. Since organisation of healthcare systems varies among countries, the type of staff who performed the preoperative assessment was not considered as an inclusion criterion. The European Society of Anaesthesiology guidelines recommend that the anaesthesiologists must complete the preoperative assessment while trained nurses or anaesthesia trainees should perform the screening.[8] A preoperative evaluation performed by an internist was associated with increased length of stay and increased postoperative mortality.[48] The results of this systematic review may have been affected by the heterogeneity in the types of staff performing the preoperative assessment.

We exclusively included studies with high internal validity. Therefore, several retrospective studies were excluded. Nonetheless, as the remaining studies´ risk of bias was fairly high, and they were heterogeneous, a meta-analysis was not statistically appropriate.[26] The included studies' designs could not rule out selection bias and confounders; thus, the strength of the evidence should be assessed cautiously. Many studies did not adjust for several confounders, which could be responsible for the observed effects. Several studies lacked descriptions of the methods used and the patients included, lowering transparency. The results are relevant to health care services, focusing on the well-being and safety of the patients.

Implications for future research and practice

This systematic review identified the ambiguity in the PAC interventions offered to the intervention group. In many studies, it was evident that the methods used lacked clarity, and high-quality research is needed in this field. The included studies did not demonstrate earlier surgical room entry time[49,50] or reduction in the number of preoperative tests for patients attending the PAC, similar to the results of the retrospective studies.[27] Other implications may include the organisation structure of different PACs and their functioning. Additionally, the tests that should be part of the assessment at the PACs should be investigated. The use of technology, such as streaming services, facilitates different patient groups and might become crucial for reducing human contact and spread of infection in context of coronavirus disease 2019.

CONCLUSION

PAC use has reduced the length of stay and surgery cancellation rate at hospitals. However, the effectiveness of PAC, the major review question, remains unclear, and requires further research. There is a demand for high-quality studies capturing robust data describing the quality of care and clinical outcomes for patients requiring anaesthesia. This requires increased focus and funding for this specific area of health services research and could, therefore, lead to implementation of PACs in health care services and improve patient safety and perioperative care.

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Competing Interests

The authors declare that they have no conflict of interest.

Data sharing statement

All data relevant to the study are included within the article or have been uploaded within supplemental files.

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Author contributions

EWK, MF, AO, and TOT: Study design

EWK, MF, AO: Search and screening of the articles

EWK: Data extraction

MF, AO, RCB, and TOT: Control of data extraction

EWK, MF, AO, and RCB: Quality assessment of the included articles

EWK: Drafting of the manuscript

MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript

MF, AO, RCB, and TOT: Supervised the study

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Figure legends

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [23]

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [29]

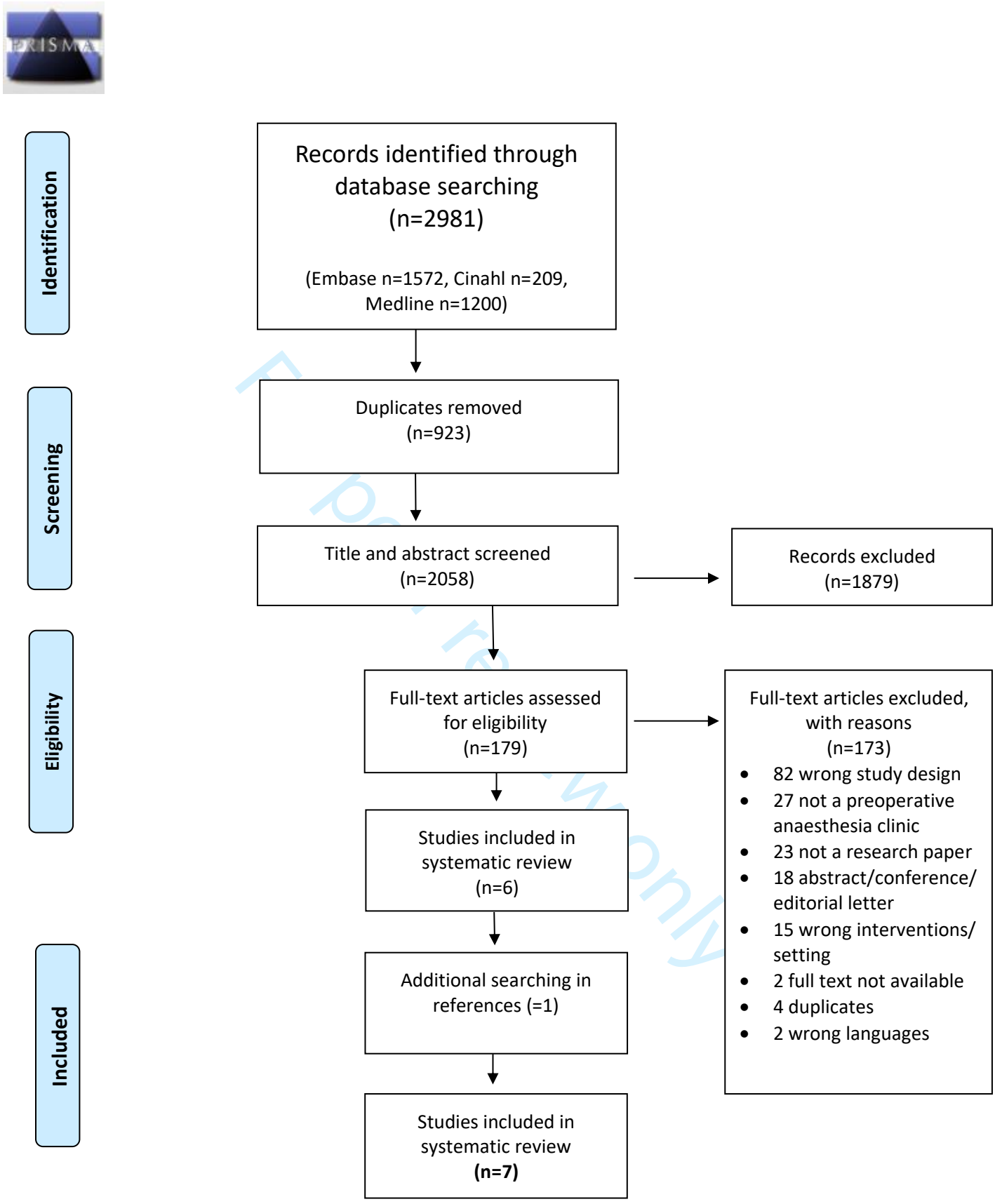

Figure 1: Prefferd Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [24]

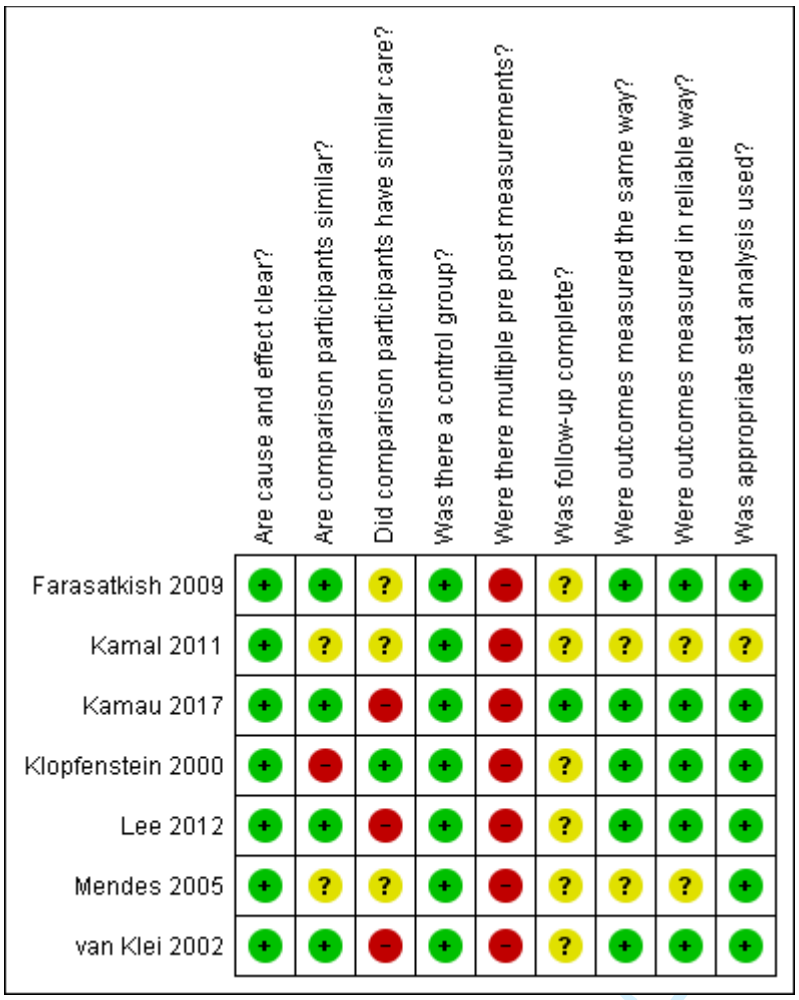

Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental studies was used for the risk of bias assessment. [30]

Appendix 1: Search strategies

Table of Content

1. Database Search Strategies

The search mode for CINAHL was Boolean/Phrase. For those searches that are done without search fields - it is automatically searched in the standard fields that CINAHL uses, including words from title, summary, and subject headings.
Search 1 and Search 2 are with words in the title (TI in front of the keywords), however this have not been done with the other searches.

Embase and Medline have the same search mode because we are searching for words from title, summary, and subject headings.

2. Initial searches, 11 September 2018

2.1. Main Databases

Database: Embase, (Ovid)

Results: n=1287
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab. (689)
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=997
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 remove duplicates from 9

Database: Cinahl Plus with Full Text (EBSCOhost)

Results: n=132
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-20181231; Exclude MEDLINE records

3. Search update, 3 February 2020

3.1. Main Databases

Database: Embase (Ovid)

Results: n=1453
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2

4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1105
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=166
Search:
1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
7 S3 OR S4 OR S5 OR S6 OR S7 487
8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

4. Search update, 4 February 2021

4.1. Main Databases

Database: Embase (Ovid)

Results: n=1572
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab.
8 or/3-7
9 limit 8 to yr="1996 -Current"
10 limit 9 to (conference abstracts or embase)

Database: Medline (Ovid)

Results: n=1200
Search:
1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or evaluat*)).ti.
2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
3 1 and 2
4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.

5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre anesthe*)).ti,ab.
6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or measurement*)).ti,ab. (4)
8 or/3-7
9 limit 8 to yr="1996 -Current"

Database: Cinahl Plus with Full Text (EBSCO host)

Results: n=209
Search:
1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or measurement* or evaluat*))
2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
3 S1 AND S2
4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30
7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or assessment* or measurement*)
8 S3 OR S4 OR S5 OR S6 OR S7
9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-; Exclude MEDLINE records

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	3-5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	6
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	5-6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	5-6+App. 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	6-7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	6-7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	7, 12
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	7
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	7
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	7
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	7
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	7
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	6-7
Certainty	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	6-7

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
assessment			
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	7
Study characteristics	17	Cite each included study and present its characteristics.	9-10
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	12
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	8-16
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	8-16
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	12
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	12
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	12
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	12
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	12
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	16
	23b	Discuss any limitations of the evidence included in the review.	19
	23c	Discuss any limitations of the review processes used.	19
	23d	Discuss implications of the results for practice, policy, and future research.	19-20
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2-5
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	2-5
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	2-5
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	21
Competing interests	26	Declare any competing interests of review authors.	20
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	20-21

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

PRISMA 2020 Checklist

For more information, visit: http://www.prisma-statement.org/