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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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3 1 **The effect of pre-anaesthetic assessment clinic: a systematic review of randomised and**
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5 2 **non-randomised prospective controlled studies**
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3 24 **ABSTRACT**

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5 25 **Objectives:** The aim of this systematic review was to examine the effectiveness of pre-
6
7 26 anaesthetic assessment clinics (PACs) implemented to improve quality and patient safety in
8
9 27 perioperative care.

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11 28 **Design:** Systematic review.

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13 29 **Data sources:** The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline,
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15 30 and Embase (OvidSP) were systematically searched from 1st April, 1996 to 4th February,
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17 31 2021.

18
19 32 **Eligibility criteria:** The main inclusion criterion was that the study, using empirical
20
21 33 quantitative methods, addressed the effectiveness of PACs.

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23 34 **Data extraction and synthesis:** Titles, abstracts, and full texts were screened in duplicate by
24
25 35 two authors. Risk of bias assessment, using the Joanna Briggs Institute critical appraisal
26
27 36 checklist for quasi-experimental studies, and data extraction were performed by one author
28
29 37 and checked by the other author. Results were synthesised narratively owing to the
30
31 38 heterogeneity of the included studies.

32
33 39 **Results:** Seven prospective controlled studies were conducted. Most studies had a high risk
34
35 40 of bias. Three studies reported a significant reduction in the length of the hospital stay, and
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37 41 two studies reported a significant reduction in cancellation of surgery for medical reasons
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39 42 when patients were seen in the PAC. In addition, the included studies presented mixed
40
41 43 results regarding anxiety in patients.

42
43 44 **Conclusion:** This systematic review demonstrated a reduction in the length of hospital stay
44
45 45 and cancellation of surgery when the patients had been assessed in the PAC. There is a need
46
47 46 for high-quality prospective studies to gain a deeper understanding of the effectiveness of
48
49 47 PACs.

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49 48 **PROSPERO registration number:** CRD42019137724

50
51 50 **Keywords:** pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic
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53 51 review

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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

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3 85 surgery-related and linked to organisational structures.[8] Future efforts should improve
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5 86 preoperative anaesthesia safety,[9] by improving planning and preparation for elective
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8 87 procedures and interventions.
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10
11 88 In 1949, Lee discussed the value of the “anaesthetic outpatient clinic” in the preparation of
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14 89 patients for surgery.[10] Today, an increasing number of pre-anaesthesia assessment clinics
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16 90 (PACs) are supporting hospitals in handling the rise in the number and complexity of surgical
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19 91 procedures.[11] The PAC consultation, conducted by the anaesthesiologist, anaesthesia
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21 92 nurse, or both, is globally recognised as an evaluation method while optimising the patients’
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24 93 medical condition prior to surgery and anaesthesia, and is considered essential in securing
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26 94 anaesthetic practice since it detects anaesthesia-related risk factors and high-risk patients,
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29 95 improves patient outcomes, prepares the patient physically and psychologically for
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31 96 anaesthesia, and ensures the patient’s most favourable condition for surgery and
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34 97 anaesthesia.[12-14] Considering the well-prepared patients and staff, several researchers
35
36 98 posit that with PAC, the number of surgical cancellations, length of hospital stay, and
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39 99 mortality rate are reduced, and tests are minimised.[8,15,16] Others assert that patients feel
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41 100 less anxious regarding the subsequent anaesthetic and surgical processes and are highly
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44 101 satisfied with this service when PACs are used.[15,17,18]
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47 102 As Turunen *et al.* state, research on PACs is scarce regarding costs, financial savings, the
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49 103 impact on patient safety and quality of care, accuracy of operative patients, and effect on
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52 104 preoperative nursing levels.[19] Survey results indicate that anaesthesiologists perceive day
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54 105 of surgery delays due to missing information as common, even with PAC consultations.[20]
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57 106 The present systematic review examines the outcomes of PAC as systematic work on quality
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3 107 and patient safety, including identifying the areas for improvement, implementing
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5 108 interventions, and ensuring that patient outcome improvement.
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9 109 **METHODS**

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11 110 The aim of this systematic review was to examine the effectiveness of PACs in improving
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13 111 quality and patient safety in preoperative care. A further aim was to determine the gaps in
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15 112 existing knowledge for future research. Our systematic review followed the guidelines in the
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17 113 Cochrane Handbook for Systematic Reviews of Interventions [21] and was reported in
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19 114 accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses
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21 115 (PRISMA) guidelines.[22] The protocol was published in PROSPERO: CRD42019137724.[23]
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24 116 We had two review questions:
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- 30 117 1. What are the effects of PACs on patient satisfaction, anxiety, and safety?
- 31
32 118 2. What are the effects of PACs on cancellation rate, cost, and efficiency?
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36 119 **Search strategies**

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38 120 We performed a scoping search in different databases to identify the key terms for the
39
40 121 literature search.[24,25] The final search was planned and conducted in close collaboration
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42 122 with a university librarian. On 11th September, 2018 we searched CINAHL Plus with Full Text
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44 123 (EBSCOhost), Medline, and Embase (OvidSP), and updated it on 4th February, 2021.
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46 124 Considering the lack of subject headings (e.g., MeSH) for PAC, we used text words such as
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48 125 preanaesthesia. The search in Medline is presented in Appendix 1. The search mode in
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50 126 CINAHL was Boolean/Phase, which supports Boolean searching or exact phrase searching. To
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52 127 ensure comprehensiveness, we used both the truncation and proximity operators. We
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54 128 limited the search to 1996 since this was the year one of the first known articles in this area
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3 129 was published.[23] Complementary methods to identify studies included following up on
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5 130 citations via Scopus, scanning the reference lists of relevant papers and included articles,
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8 131 and checking for relevant studies in clinical trials.[24]
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10 132 **Eligibility criteria**

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13 133 Considering the aim of the review, the main inclusion criterion was that the study, using
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15 134 empirical quantitative methods, addressed the effectiveness of PACs. Specific study
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18 135 eligibility criteria were: (a) published in English or Scandinavian language, (b) scientific
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20 136 publication of original research, (c) reporting the outcomes of PAC, (d) PAC consultation with
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23 137 the patient present, (e) randomised or non-randomised prospective controlled studies, and
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25 138 (f) newly established PAC. We excluded: (a) editorials, discussion papers, and conference
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28 139 abstracts, (b) reviews, (c) instrument testing, (d) studies with children, and (e) retrospective
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30 140 studies.
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32 141 **Study selection**

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35 142 All references identified in the search were transferred to EndNoteX9, where the duplicates
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38 143 were removed. Next, all unique references were transferred to the Covidence screening
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40 144 tool.[26] Study eligibility was ascertained independently by two authors, first at the title and
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42 145 abstract level, and subsequently at the full text. Inclusion was determined by consensus, and
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45 146 disagreements were resolved by consulting a third author.
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47 147 **Quality assessment**

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50 148 We used design-specific checklists to assess the studies' risk of bias. Given the
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52 149 methodological similarity of the included studies, only the Joanna Briggs Institute Critical
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54 150 appraisal checklist for quasi-experimental studies was used.[27] One author performed the
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57 151 risk of bias assessment, and the other checked the accuracy of the assessment.
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3 152 Disagreements were resolved through discussion with a third author. Each of the nine
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5 153 checklist questions was answered no, yes, unclear (or not applicable).
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8 154 **Data extraction and analysis**

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10 155 One author extracted data from each included study onto a pre-designed Excel spreadsheet,
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12 156 and another checked the extracted data for accuracy, consistency, and completeness.

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15 157 Extracted information included publication details, study design, setting, and characteristics
16
17 158 of the patients, interventions, comparisons, and outcome (PICO). We requested information
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19 159 on the missing data; however, received no response from the author. If the PICO elements
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21 160 were sufficiently similar and statistical data were available, we had planned to conduct
22
23 161 meta-analyses. However, the extracted data revealed substantial heterogeneity among the
24
25 162 studies, and there were no randomised controlled trials (RCTs). Therefore, we performed a
26
27 163 narrative synthesis, describing and comparing the main findings from the included studies,
28
29 164 and discussing their methodological strengths and weaknesses.
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34 165 **RESULTS**

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37 166 Figure 1. provides details of the study selection process. A total of 2250 records were
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39 167 identified in the first search and 742 in the second search. After removing duplicates, we
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41 168 screened 2372 records based on the title and abstract; of these, 179 records passed the full-
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43 169 text screening. We included seven studies that met the inclusion criteria.
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47 170 **Overall characteristics of the studies**

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49 171 The seven included studies are listed in Table 1. They were all in English and published in
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51 172 2000–2017, with data collected in the years 1997–2015 (one did not provide this data
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53 173 collection information).[28] Based on our inclusion criteria, all were prospective controlled
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55 174 studies, but we found no RCTs. There was one controlled before-after study.[34] The other
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57 175 six studies had control groups but no baseline assessments, only assessments following PAC
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3 176 implementation. There were three 2-group non-parallel after-only studies,[29,30,32] and
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6 177 three 2-group parallel after-only studies [28], where one had a matched control group[31]
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8 178 and one had three follow-up assessments of one arm.[33] In total, the studies included
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10 179 77411 patients.
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180 **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)

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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

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

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

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

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3 The patients were scheduled to undergo a variety of surgeries, including orthopaedic,[29-
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5 31,34] urology,[28,30,31,34] general,[30,31,34] heart,[32] gynaecology/obstetrics,
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7 [30,31,34] vascular surgery,[30] ophthalmology,[30] maxillofacial/dental surgery,
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9 [30,34]neurological surgery,[30] and one did not specify the type of surgery.[33] In five
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11 studies, the type of anaesthesia was not specified,[29,30,32-34] and two studies reported
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13 patients for general and/or regional supplement.[28,31]
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20 The patients included had previous anaesthetic experience in one study,[28] previous and no
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22 previous anaesthetic experience in another,[34] and five studies did not report this data.[29-
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24 33] Limited background characteristics of the patients were reported in two studies.[29,33]
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26 One stated that the patients included had ASA 3 or 4 and a body mass index of more than
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28 40. However, no ASA number, sex, or age was reported in the article.[29] Mendes *et al.* did
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30 not report any background characteristics of the included patients.[33]
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35 **Description of the studies' risk of bias**

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

50 The outcomes of the included studies are described separately below.
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54 *Satisfaction*

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56 One study reported satisfaction as an outcome.[31] The summarised patient satisfaction
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58 with the anaesthetic consultation score out of 100 showed that patients in the PAC group
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3 were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%;
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5 $p=0.01$).[31] There was no statistically significant difference between the two groups in the
6
7 mean patient satisfaction with perioperative anaesthesia care score out of 5 after surgery
8
9 (mean difference 0.01%, $p=0.94$).[31] The mean quality of recovery (QoR) score (range, 0–
10
11 18) following anaesthesia on the first day of surgery was similar between the intervention
12
13 (13.17±2.73) and control (13.31±2.65) groups ($p=0.67$).[31] The QoR measure is the patients'
14
15 health-related quality of life.[35]

20 *Anxiety*

22 Three studies reported anxiety.[28,31,34] Two studies reported the visual analogue scale
23
24 (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[28] another used a 100
25
26 mm horizontal line with “not anxious at all” to “extremely anxious”[31] In one study, the
27
28 median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control
29
30 group ($p=0.0038$).[28] In another study, there were no significant differences between the
31
32 control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively,
33
34 $p=0.12$), and anaesthesia (20 vs. 19, respectively, $p=0.60$).[31] The median Multiple Affect
35
36 Adjective Check List (MAACL) score with possible range scores from 0 to 21 (higher scores
37
38 indicating greater levels of anxiety) was 3 (0–9) in the intervention group and 6.5 (2–12) in
39
40 the control group ($p=0.0053$).[28] The differences in the State-Trait Anxiety Index (STAI)
41
42 score, which is composed of 40 questions rated on a 4-point Likert scale, was 1.51, 95% CI:
43
44 1.02–2.02%, $p=0.0051$).[34] The results on anxiety in these two studies were significant.
45
46
47 However, Kamau *et al.*[34] found no differences when they examined anxiety and the
48
49 influences of sex, duration of hospital stay, and prior anaesthesia experience.

56 *Mortality*

1
2
3 One study reported the mortality rates.[29] Patients attending the High Dependency Unit
4 (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex
5
6 orthopaedic surgery had a significant reduction in mortality rate after being assessed in the
7
8 PAC, from 18 (6.1%) of 298 patients before to 14 (1.2%) of 1147 patients after $p=0.001$. [29]
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12 *Cancellation rate*

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15 Three studies reported a reduced cancellation rate following the establishment of a
16
17 PAC.[30,32,33] One of the included studies had 316 (2.0%) cancellations for medical reasons
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19 before the introduction of PAC, and 79 (0.9%) after, and a difference of 1.02% (95% CI, 0.31–
20
21 1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%). [30] The overall
22
23 cancellation of surgery was reduced from 1027 (6.3%) to 393 (4.6%) following surgery, and a
24
25 difference of 0.9% (95% CI, 0.3–1.0%) when patients were assessed in PAC.[30] Mendes *et*
26
27 *al.*[33] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p\leq$
28
29 0.05. There were 469 (number of cancellations)/10639 (number of surgeries performed) due
30
31 to medical reasons in the first year of this study. The following year, a considerable increase
32
33 above the baseline values in the intervention group was observed, followed by a progressive
34
35 decrease in the last year with 391 (number of cancellations)/10397 (number of surgeries
36
37 performed).[33] Farasatkish *et al.* reported that of the 1716 patients studied, 15.1 % of cases
38
39 cancelled in the two groups. The cancellation rates in the control group were 146/866
40
41 (16.8%), and the cancellation rate in the intervention group was 113/850 (13.29%) $p=0.046$.
42
43 The most common reason for cancellation was incomplete medical work-up 51/146 (35%) in
44
45 the control group and 32/113 (28%) in the intervention group, $p=0.03$. [32] Lee *et al.* found
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47 similar rates for surgery being cancelled on the scheduled date for the intervention group
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49 compared to the control group (2.3% vs. 3.4%, $p=0.75$). [31]
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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

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3 admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p=0.01$), and HDU (14/298 [4.7%],
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5 85/1147 [7.4%], $p=0.1$) increased after implementing a PAC.[29] The number of PAC
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7 evaluations increased from year 1, 4704 to year 4, 13990 ($p\leq 0.001$).[33] The number of
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9 outpatient procedures increased from 2170 (year 1) to 1943 (year 4) ($p\leq 0.001$), and the
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11 inpatient procedures decreased from 9556 (year 1) to 8449 (year 4), ($p\leq 0.001$).[33]
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16 **DISCUSSION**

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18 This systematic review summarises the effectiveness of PACs in improving quality and
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20 patient safety in general hospitals and determines the gaps in existing knowledge for future
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22 research. Seven studies that met the inclusion criteria were included. We present the main
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24 results and infer the implications for research and practice in the following text.
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32 Cancellation on the day of surgery has undesirable effects on both the patients and the
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34 hospital system.[14] Thus, studies have found that late patient-related cancellations could
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36 totally or partially be prevented,[36] if they were addressed during preoperative
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38 evaluations.[14,15] This is confirmed by several studies in this systematic review that found
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40 a reduction in surgery cancellation after implementing a PAC.[30,32,33] However, Lee *et al.*
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42 found no significant changes between the intervention and control groups.[31] Mendes and
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44 colleagues found that the number of cancellations for medical reasons after PAC
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46 implementation decreased in the first year of implementation. In the second and third years,
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48 they were higher before the number dropped to below baseline.[33] These conflicting
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50 findings might show that hospitals operate in a specific context, with unique populations,
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52 processes, and microsystems, which may encounter unique obstacles making
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54 implementation difficult. Patient-focused interventions need to consider barriers,
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3 facilitators, and interrelationships between systems, staff, and interventions to increase the
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5 likelihood of sustainable success.[37] In addition, Kamau *et al.* also indicated that PACs lead
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7 to more planned admissions to the ICU, HDU, and PACU, which is more predictable for
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9 patients, staff, and administrations.[34]
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14 Another main finding of this systematic review was a significant reduction in the length of
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16 hospital stay following patients' examination in a PAC; however, a small number of studies
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18 with low quality were considered. Nevertheless, similar results were found in another
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20 systematic review claiming that perioperative systems support hospitals to address the
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22 expected growth in the number and complexity of surgical procedures being performed.[15]
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24 However, Lee *et al.* indicated that the reason for the reduced length of hospital stay was the
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26 mean duration of stay before surgery in the intervention group.[31] This indicates that when
27
28 patients are examined in the PAC and well prepared with information, consultations, and
29
30 tests, they do not need to be hospitalised until the day of surgery. A survey focusing on
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32 patients operated showed that if they had a choice, 75% do not wish to be admitted to the
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34 hospital until the same day of operation. One of the main reasons was to spend less time in
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36 the hospital.[38] However, an updated systematic review on the effectiveness of nurse-led
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38 preoperative assessment services for elective surgery found that the included articles had a
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40 reduced length of stay. The included studies had low methodological quality, and therefore,
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42 the authors could not conclude that this service leads to reduced length of hospital stay.[16]
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53 The evidence from this systematic review is insufficient to conclude whether patients have
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55 reduced anxiety when assessed using PAC. The included studies used different instruments
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57 to measure the levels of anxiety, and the results could not be pooled. In addition, previous
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3 studies have shown that anxiety levels were higher in women.[39] Seventy-eight per cent of
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5 the participants were women in one of the included studies in this systematic review and
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7 might result in a bias in this study.[34] Anxiety was also statistically higher in patients who
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9 underwent general anaesthesia than in those who underwent regional anaesthesia.[40] The
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11 included studies on anxiety included both patients with general and regional anaesthesia,
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13 which might also be biased. Furthermore, the patients included in this review had both
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15 former surgical experience and no experience with surgery. However, studies have shown
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17 that former experience with anaesthesia and surgery reduces the risk of preoperative
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19 anxiety.[41]
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28 Assessment of PAC was significantly associated with reduced mortality following complex
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30 orthopaedic surgery.[29] Previously published retrospective studies found similar results,
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32 but with other types of surgery.[42,43] A Danish study found that deaths attributed to
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34 anaesthesia were associated with insufficient or inadequate preoperative evaluation.[7]
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36 Furthermore, a previous study pointed out that the risk factors are not only patient-related
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38 but also organisation-related,[8] and that some hospitals have perioperative care and teams
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40 that are better at identifying and rescuing perioperative complications.[44,45] However,
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42 Blitz *et al.* argued that PAC should focus on early patient engagement strategies,
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44 interdisciplinary team communication, detailed perioperative care plans, and patient
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46 documentation in the electronic health record. This record should be open for review by the
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48 perioperative team to preserve patient information and safety. The value of a PAC lies in its
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50 ability to improve the quality of the perioperative process by designing a more robust
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52 system for preoperative assessment and preparation.[42] The importance of safety in
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3 anaesthesia is a vital component in anaesthesia practice, and the use of PACs contributes to
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5 this critical area.
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8 **Strengths and limitations of the study**

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10 Most review steps were performed in duplicate or independently by two researchers, and
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12 agreement was reached in a consensus meeting. However, grey literature, such as
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14 government and institutional documents, was not included and might be a limitation to this
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16 study. Since countries have different organisational structures in their healthcare systems,
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18 we did not set inclusion criteria concerning who performed the patient's preoperative
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20 assessment. However, the European Society of Anaesthesiology guidelines recommend that
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22 anaesthesiologists complete the preoperative assessment, while trained nurses or
23
24 anaesthesia trainees perform the screening.[8] A preoperative evaluation performed by an
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26 internist has been associated with increased length of stay and increased postoperative
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28 mortality.[46] This systematic review's results were possibly affected by the heterogeneity in
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30 the types of staff performing the preoperative assessment.
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40 We opted to include only the studies with the highest internal validity. Thus, we excluded
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42 several retrospective studies. Nonetheless, the remaining studies' risk of bias was fairly high,
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44 and they were heterogeneous. As a result, meta-analyses were not statistically
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46 appropriate.[25] The included studies' designs could not rule out selection bias and
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48 confounding, and the strength of the evidence should be assessed cautiously. Many studies
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50 did not make adjustments for several confounders, which could be responsible for the
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52 observed effects. Several studies lacked descriptions of the methods used and the patients
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54 included, which lowered the transparency. It is not very reassuring that many such studies
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56 were unable to deliver more thorough evidence to guide practice and should be assessed
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3 cautiously. The results are relevant to health care services, which should focus on the well-
4
5 being and safety of the patients.
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7 8 **Implications for future research and practice** 9

10 This systematic review identified the ambiguity in the PAC interventions offered to the
11
12 intervention group. In many studies, it was evident that the methods used in these studies
13
14 were not always clearly described, and high-quality research is needed in this field. The
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16 included studies in this review did not contain any results of reduced preoperative tests,
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18 such as blood tests, on patients before surgery when patients attended the PAC,[47,48] and
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20 earlier surgical room entry time for patients assessed in PACs,[49,50] similar to previous
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22 retrospective studies. Other implications for future research might be the organisation
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24 structure of different PACS and their functioning. The use of technology, such as streaming
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26 services, facilitates different types of patient groups and might be more important with the
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28 appearance of Covid-19 in reducing human contact and spread of the virus.
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34 35 **CONCLUSION** 36

37 This systematic review suggests that PAC use reduces the length of hospital stay, and the
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39 majority of the studies had reduced the cancellation rate in hospitals. These findings are an
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41 essential contribution to the current evidence in this field. In addition to further research in
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43 this field, the demand for increased high-quality studies to capture robust data describing
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45 the quality of care and clinical outcomes for patients requiring anaesthesia. This step
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47 demands increased focus and funding for this specific area of health services research and
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49 could, therefore, lead to new implementations of PAC's in health care services and further
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51 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

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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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3 *Care* 1999;**27**:481–8. doi: [10.1177/0310057X9902700508](https://doi.org/10.1177/0310057X9902700508) [Published online first:
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5 1999/10/16].
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12 [10.1097/00000542-200510000-00025](https://doi.org/10.1097/00000542-200510000-00025).
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16
17 issues with potential impact on operating room efficiency. *Anesthesiology*
18
19 2006;**105**:1254–9; doi: [10.1097/00000542-200612000-00026](https://doi.org/10.1097/00000542-200612000-00026) [Published online first:
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21 2006/11/24].
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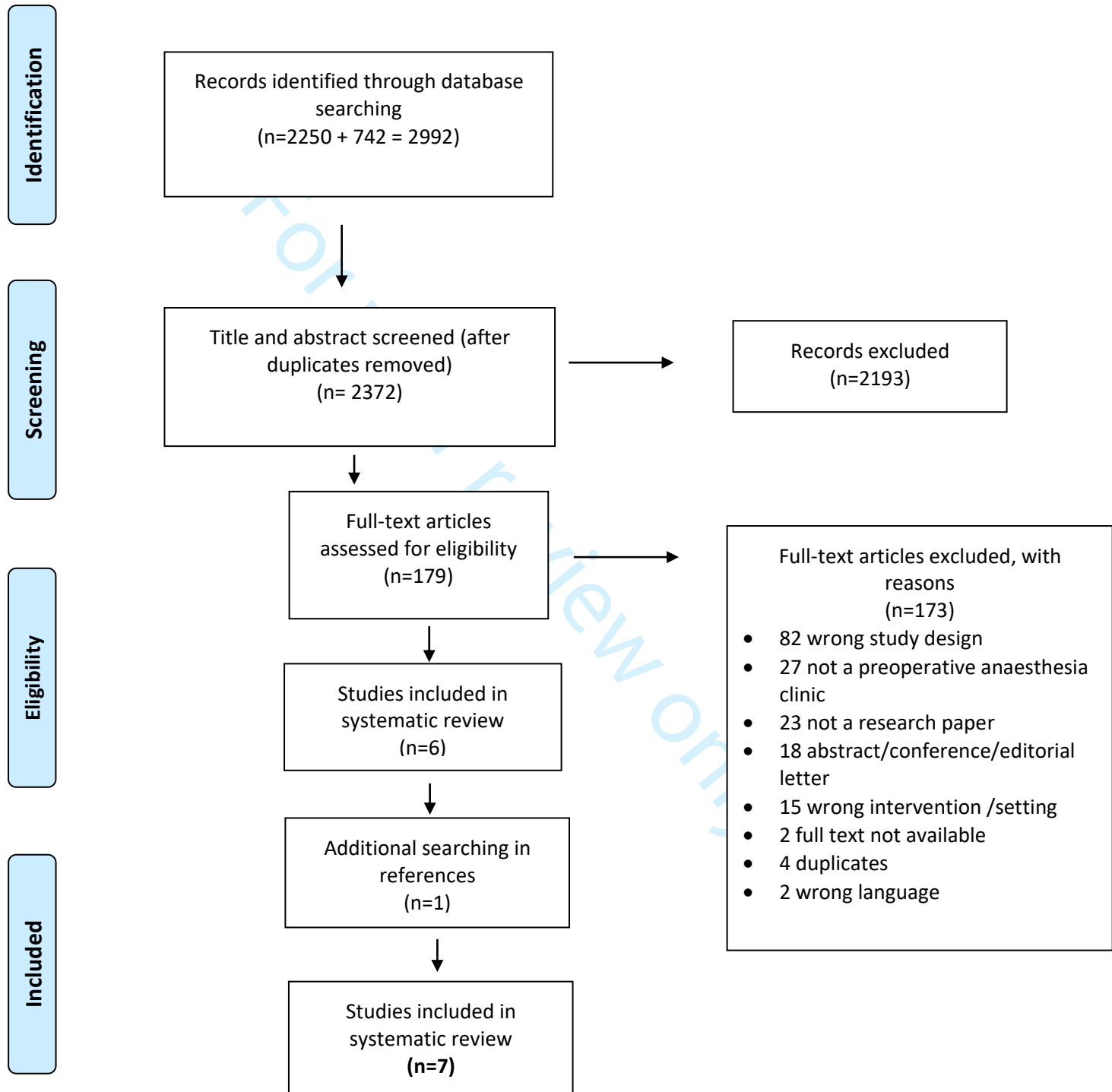
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For peer review only

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Figure 1: PRISMA Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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

For peer review only - <http://bmjopen.bmj.com/site/about/guidelines.xhtml>

Figure 2: The risk of bias assessment

	Are cause and effect clear?	Are comparison participants similar?	Did comparison participants have similar care?	Was there a control group?	Were there multiple pre post measurements?	Was follow-up complete?	Were outcomes measured the same way?	Were outcomes measured in reliable way?	Was appropriate stat analysis used?
Farasatkish 2009	+	+	?	+	-	?	+	+	+
Kamal 2011	+	?	?	+	-	?	?	?	?
Kamau 2017	+	+	-	+	-	+	+	+	+
Klopfenstein 2000	+	-	+	+	-	?	+	+	+
Lee 2012	+	+	-	+	-	?	+	+	+
Mendes 2005	+	?	?	+	-	?	?	?	+
van Klei 2002	+	+	-	+	-	?	+	+	+

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

4 Search Strategy:
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- 8 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or measurement* or
9 evaluat*)).ti. (6182)
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11 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti. (1472922)
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13 3 1 and 2 (478)
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16 anesthe*) adj4 (assessment* or measurement* or evaluat* or clinic* or nurs* or unit* or outpatient* or
17 ward* or center* or centre*).ti,ab. (572)
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19 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat* or clinic* or unit* or
20 nurs* or outpatient* or ward* or centre* or center*)) and (surg* or anaesthe* or anesthe* or
21 preoperativ* or pre-operativ* or preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
22 preanesthe* or pre anesthe*).ti,ab. (241)
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24 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab. (138)
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26 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or assessment* or
27 measurement*).ti,ab. (4)
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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.

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

In your methods section, say that you used the PRISMA reporting 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

1	Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
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6	Methods			
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9	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
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14	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 rationale	6
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21	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
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28	Search	#8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5 + APPENDIX
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33	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
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38	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
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45	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
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50	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
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57	Summary measures	#13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
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1	Planned	#14	Describe the methods of handling data and combining	7
2	methods of		results of studies, if done, including measures of	
3	analysis		consistency (e.g., I ²) for each meta-analysis.	
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6	Risk of bias	#15	Specify any assessment of risk of bias that may affect the	11-12
7	across studies		cumulative evidence (e.g., publication bias, selective	
8			reporting within studies).	
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11	Additional	#16	Describe methods of additional analyses (e.g., sensitivity or	N/A
12	analyses		subgroup analyses, meta-regression), if done, indicating	
13			which were pre-specified.	
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17	Results			
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19	Study selection	#17	Give numbers of studies screened, assessed for eligibility,	8
20			and included in the review, with reasons for exclusions at	
21			each stage, ideally with a flow diagram .	
22				
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24	Study	#18	For each study, present characteristics for which data were	N/A
25	characteristics		extracted (e.g., study size, PICOS, follow-up period) and	
26			provide the citation.	
27				
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29				
30	Risk of bias	#19	Present data on risk of bias of each study and, if available,	11-12
31	within studies		any outcome-level assessment (see Item 12).	
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34	Results of	#20	For all outcomes considered (benefits and harms), present,	14-17
35	individual studies		for each study: (a) simple summary data for each	
36			intervention group and (b) effect estimates and confidence	
37			intervals, ideally with a forest plot.	
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40	Synthesis of	#21	Present the main results of the review. If meta-analyses are	14-17
41	results		done, include for each, confidence intervals and measures	
42			of consistency.	
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46	Risk of bias	#22	Present results of any assessment of risk of bias across	N/A
47	across studies		studies (see Item 15).	
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50	Additional	#23	Give results of additional analyses, if done (e.g., sensitivity	N/A
51	analysis		or subgroup analyses, meta-regression [see Item 16]).	
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54	Discussion			
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56	Summary of	#24	Summarize the main findings, including the strength of	18-20
57	Evidence		evidence for each main outcome; consider their relevance	
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1 to key groups (e.g., health care providers, users, and policy
2 makers

3
4 **Limitations** [#25](#) Discuss limitations at study and outcome level (e.g., risk of 20-21
5 bias), and at review level (e.g., incomplete retrieval of
6 identified research, reporting bias).
7

8
9 **Conclusions** [#26](#) Provide a general interpretation of the results in the context 22
10 of other evidence, and implications for future research.
11

12 **Funding**

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15 **Funding** [#27](#) Describe sources of funding or other support (e.g., supply of 23
16 data) for the systematic review; role of funders for the
17 systematic review.
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21 None The PRISMA checklist is distributed under the terms of the Creative Commons Attribution
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23 made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)
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BMJ Open

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

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Manuscript ID	bmjopen-2021-054206.R1
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Primary Subject Heading:	Anaesthesia
Secondary Subject Heading:	Surgery, Nursing, Health services research
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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3 1 **Effectiveness of pre-anaesthetic assessment clinic: a systematic review of randomised and**
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10 4 Eirunn Wallevik Kristoffersen^{1,2} *, Anne Opsal¹, Tor Oddbjørn Tveit^{1,2,3}, Rigmor C Berg^{4,5},
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3 24 **ABSTRACT**

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5 25 **Objectives:** The aim of this systematic review was to examine the effectiveness of pre-
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7 26 anaesthetic assessment clinics (PACs) implemented to improve quality and patient safety in
8
9 27 perioperative care.

10
11 28 **Design:** Systematic review.

12
13 29 **Data sources:** The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline,
14
15 30 and Embase (OvidSP) were systematically searched from 1st April, 1996 to 4th February,
16
17 31 2021.

18
19 32 **Eligibility criteria:** The main inclusion criterion was that the study, using empirical
20
21 33 quantitative methods, addressed the effectiveness of PACs.

22
23 34 **Data extraction and synthesis:** Titles, abstracts, and full texts were screened by a team of
24
25 35 three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal
26
27 36 checklist for quasi-experimental studies. Data extraction was performed by one author and
28
29 37 checked by four other authors. Results were synthesised narratively owing to the
30
31 38 heterogeneity of the included studies.

32
33 39 **Results:** Seven prospective controlled studies, on the effectiveness of PACs, were included.
34
35 40 Three studies reported a significant reduction in the length of the hospital stay, and two
36
37 41 studies reported a significant reduction in cancellation of surgery for medical reasons when
38
39 42 patients were seen in the PAC. In addition, the included studies presented mixed results
40
41 43 regarding anxiety in patients. Most studies had a high risk of bias.

42
43 44 **Conclusion:** This systematic review demonstrated a reduction in the length of hospital stay
44
45 45 and cancellation of surgery when the patients had been assessed in the PAC. There is a need
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47 46 for high-quality prospective studies to gain a deeper understanding of the effectiveness of
48
49 47 PACs.

50
51 48 **PROSPERO registration number:** CRD42019137724

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55 50 **Keywords:** pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic
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57 51 review

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58 **Strengths and Limitations of this study**

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

67 **INTRODUCTION**

68 Anaesthesia is crucial in surgery. However, it may activate physiological changes that
69 increase morbidity and mortality, [1] depending on the patients' preoperative health status
70 and age. [2] Hospitals treat patients with complex, comorbid healthcare problems
71 undergoing progressively extensive surgeries and interventions. [3,4] To ensure the quality
72 and safety of anaesthesia and surgery, precise knowledge of the clinical characteristics of
73 patients undergoing surgery is critical to the perioperative treatment plan. [2] Over the past
74 50 years, perioperative mortality, including anaesthesia-related mortality, has declined,
75 which is significant in developed countries, [1,5] mainly due to new anaesthetics, improved
76 monitoring equipment and training, availability of recovery rooms, and improved airway
77 management. [4] However, an Australian study reported that 14% of anaesthetic-surgical
78 complications and 39% of deaths attributed to anaesthesia were associated with insufficient
79 and/or inadequate preoperative evaluation. [6] A Danish retrospective investigation showed
80 that the deaths among patients undergoing surgery could be prevented by thorough
81 preoperative evaluation, [7] indicating that risk factors are both patient-and surgery-related
82 and linked to organisational structures. [8] Future efforts should improve preoperative

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3 83 anaesthesia safety, [9] by improving planning and preparation for elective procedures and
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6 84 interventions.
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9 85 Today, an increasing number of pre-anaesthesia assessment clinics (PACs) support hospitals
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11 86 internationally in handling the rising number of patients and complexity of surgical
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14 87 procedures. [10] The design of PACs differs critically based on location, organisational
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16
17 88 structure, timing, and patient groups. They primarily function as a service unit for surgeons,
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19 89 patients, and the anaesthetic team. [11] The PAC consultation, by the anaesthesiologist,
20
21 90 anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the
22
23
24 91 patients' medical condition prior to surgery and anaesthesia. [2] Thus, it is essential for
25
26
27 92 secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk
28
29 93 patients, improves patient outcomes, prepares the patient physically and psychologically for
30
31 94 anaesthesia, and ensures the patient's most favourable condition for surgery and
32
33
34 95 anaesthesia. [12-14] This is primarily performed by interviewing and examining the patient,
35
36
37 96 reviewing previous medical, surgical and anaesthesia issues, detailed description of current
38
39 97 medication, and provisions for obtaining and reviewing preoperative tests. [11] PACs also
40
41 98 lead to increased communication between healthcare providers and coordination with
42
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44 99 postoperative care. [15,16] Due to well-prepared patients and staff, several researchers
45
46 100 posit that with PAC, the number of surgical cancellations, length of hospital stay, and
47
48 101 mortality rate have reduced, and tests are minimised. [8,17,18] Others assert that patients
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50
51 102 feel less anxious regarding the subsequent anaesthetic and surgical processes and are highly
52
53 103 satisfied with the service with PAC consultations. [17,19,20]
54
55
56 104 As Turunen *et al.* stated, research on PACs is scarce regarding costs, financial savings, the
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58
59 105 impact on patient safety and quality of care, accuracy of operative patients, and effect on
60

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3 106 preoperative nursing levels. [21] Survey results indicate that anaesthesiologists perceive day
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6 107 of surgery delays due to missing information as common, even with PAC consultations. [22]
7
8 108 This systematic review aimed to examine the effectiveness of PACs in improving quality and
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11 109 patient safety in preoperative care. Further, we aimed to determine the gaps in existing
12
13 110 knowledge for future research.

111 **METHODS**

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

116 The two review questions were:

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

119 **Search strategies**

120 We performed a scoping search in different databases to identify the key terms. [26,27] The
121 final search was planned and conducted in close collaboration with a university librarian. On
122 11th September, 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and
123 Embase (OvidSP), which was updated on 3th February 2020 and 4th February, 2021.

124 Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words such
125 as preanaesthesia, nurse, surgery, anaesthesia, preoperative, assessment, measurement,
126 evaluate, preadmission, centre, clinic, ward, unit, and outpatient. The searches are detailed
127 in Appendix 1. The search mode in CINAHL was Boolean/Phase, which supports Boolean
128 searching or exact phrase searching. For comprehensiveness, we used both the truncation

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3 129 and proximity operators. We limited the search to 1996, the year one of the first known
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5 130 articles in this area was published. [28] Complementary methods to identify studies included
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8 131 following up on citations via Scopus, scanning the reference lists of relevant papers and
9
10 132 included articles, and checking for relevant studies in clinical trials. [26]
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13 133 **Eligibility criteria**

14
15 134 The main inclusion criterion was that the study, using empirical quantitative methods,
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18 135 addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English
19
20 136 or Scandinavian language, (b) scientific publication of original research, (c) reported the
21
22
23 137 outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-
24
25 138 randomised prospective controlled studies, and (f) newly established PAC. We excluded: (a)
26
27
28 139 editorials, discussions, and conference abstracts, (b) reviews, (c) instrument testing, (d)
29
30 140 studies on children, and (e) retrospective studies.
31
32

33 141 **Study selection**

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35 142 All references identified in the search were transferred to EndNoteX9, where the duplicates
36
37
38 143 were removed. Subsequently, all unique references were transferred to the Covidence
39
40 144 screening tool. [29] Study eligibility was ascertained independently, first at the title and
41
42
43 145 abstract level, and subsequently at the full text. Three of the authors screened all the
44
45 146 articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were
46
47
48 147 resolved by consulting RCB and TOT.
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52 149 **Quality assessment**

53
54 150 Risk of bias in studies were assessed using design specific checklists. Given the
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56
57 151 methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal
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59 152 checklist for quasi-experimental studies was used. [30] Author EWK performed the risk of
60

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3 153 bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through
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5 154 discussion with MF and AO. Each of the nine checklist questions was answered no, yes,
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8 155 unclear (or not applicable).
9

10 156 **Data extraction and analysis**

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13 157 Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the
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15 158 authors confirmed the accuracy, consistency, and completeness of the extracted data that
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17
18 159 included publication details, study design, setting, and characteristics of the patients,
19
20 160 interventions, comparisons, and outcome (PICO). We requested information on the missing
21
22
23 161 data; however, received no response from the authors. If the PICO elements were
24
25 162 sufficiently similar and statistical data available, we intended to conduct meta-analyses.
26
27
28 163 However, the extracted data revealed substantial heterogeneity. Therefore, we performed
29
30 164 narrative synthesis, describing and comparing the main findings from the included studies,
31
32
33 165 and discussing their methodological strengths and weaknesses.

34 35 166 **Patient and Public Involvement**

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37 167 Patients and/or the public were not involved in the design, conduct, reporting, or
38
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40 168 dissemination plans of this research. However, the project is initiated by health
41
42 169 professionals.
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46 47 171 **RESULTS**

48
49 172 Figure 1. provides details of the study selection process. A total of 2,981 records were
50
51
52 173 identified in the final search (2021). After removing duplicates, we screened 2,058 records
53
54 174 based on the title and abstract; 179 records passed the full-text screening. We included
55
56
57 175 seven studies that met the inclusion criteria.
58

59 176 **Overall characteristics of the studies**

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3 177 The seven studies are listed in Table 1. They were all in English and published between
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5 178 2000–2017, with data collected in the years 1997–2015 (one study did not report data
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8 179 collection information). [31] Based on inclusion criteria, all were prospective controlled
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10 180 studies; however, no RCTs were found. There was one controlled before-after study. [32]
11
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13 181 The rest six studies had control groups; assessments followed PAC implementation, without
14
15 182 baseline assessments. There were three 2-group non-parallel after-only studies, [33-35]
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18 183 and three 2-group parallel after-only studies [31]; one had a matched control group [36] and
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20 184 one had three follow-up assessments of one arm. [37] One study had only cancellation rate
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23 185 as prospective data. [33] The studies included 77,411 patients.
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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),

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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)	willingness to pay (WTP) 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

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

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3 190 Considering the intervention, PACs in all studies comprised an outpatient service whereby
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5 191 patients were examined for medical conditions important for anaesthesia and informed
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7 192 regarding expectations on the day of surgery. Nevertheless, the terminology used for PACs
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10 193 varied, they served different surgical specialities, and conducted pre-anaesthesia
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12 194 consultation from ≥ 48 h to ≤ 3 months before the surgery. The settings included university
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14 195 hospital (n=3), [32,36,37] teaching hospital (n=1), [33] medical centre(n=1), [34] and general
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16 196 hospital (n=1) [35]; one study did not specify the context.[31] The staff conducting the pre-
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18 197 anaesthesia consultation also varied: in five studies, it was the anaesthesiologists, [31,33,35-
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20 198 37] in the other studies it was (also) the orthopaedic senior house officer, [35] the
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22 199 consultant or resident, [32] or the physician. [34] In three studies, nurses were part of the
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24 200 team. [33,35,36] The comparison in all studies was usual care, which generally involved a
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26 201 preoperative anaesthetic evaluation of the admitted patients the day before the surgery.
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35 203 Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and
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37 204 control groups, respectively. One study did not specify the number of patients in the
38
39 205 intervention and control groups, but only the total number of surgeries performed. [37] Five
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41 206 studies reported data for sex, showing that 51% of the patients were women and 49% were
42
43 207 men (12,129 vs. 11,583). [31-34,36] There were more women than men in both the
44
45 208 intervention (4,345 vs. 4,134) and the control groups (7,784 vs. 7,449). Five studies reported
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47 209 data for age showing that all the patients were over 20 years old [31-34,36] and four studies
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49 210 had grouped within the American Society of Anesthesiology (ASA) category. [31,34-36]
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57 212 The patients were scheduled to undergo a variety of surgeries, including orthopaedic,
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59 213 [32,33,35,36] urology, [31-33,36] general, [32,33,36] heart, [34] gynaecology/obstetrics,
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3 214 [32,33,36] vascular surgery, [33] ophthalmology, [33] maxillofacial/dental surgery,
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5 215 [32,33]neurological surgery, [33] while one did not specify the type. [37] In five studies, the
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8 216 type of anaesthesia was not specified, [32-35,37] and two studies reported patients for
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10 217 general and/or regional supplement. [31,36]

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15 219 The patients included had previous anaesthetic experience in one study, [31] previous and
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17 220 no previous anaesthetic experience in another, [32] and five studies did not report this data.
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19 221 [33-37] Limited background characteristics of the patients were reported in two studies.
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21 222 [35,37] One stated that the patients included had ASA 3 or 4 and a body mass index >40;
22
23 223 however, no ASA number, sex, or age was reported. [35] Mendes *et al.* did not report any
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25 224 background characteristics of the included patients. [37]

26 27 28 29 30 225 **Description of risk of bias in the studies**

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32 226 Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the
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34 227 cause and effect were clear. The majority of the studies measured outcomes similarly and
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36 228 used appropriate statistical analyses. Several studies had limitations of follow-up and
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38 229 similarity in care and participants. None of the patients had multiple pre-and post-
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40 230 measurements.

41 42 43 44 231 **Outcomes of the included studies**

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46 232 The outcomes of the included studies are each described separately below.

47 48 233 *Satisfaction*

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50 234 One study reported satisfaction as an outcome. [36] The summarised patient satisfaction
51
52 235 with the anaesthetic consultation score out of 100 showed that patients in the PAC group
53
54 236 were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–3.70%;
55
56 237 $p=0.01$). [36] There was no statistically significant difference between the two groups in
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3 238 mean patient satisfaction with perioperative anaesthesia care score out of 5 after surgery
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5 239 (mean difference 0.01%, $p=0.94$). [36] The quality of recovery (QoR) measure is the patients'
6
7 240 quality of recovery score. [38] The mean QoR score (range, 0–18) following anaesthesia on
8
9 241 the first day after surgery was similar between the intervention (13.17 ± 2.73) and control
10
11 242 (13.31 ± 2.65) groups ($p=0.67$). [36]

15 243 *Anxiety*

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17 244 Three studies reported anxiety. [31,32,36] Two studies reported the visual analogue scale
18
19 245 (VAS), one rated from zero (no anxiety) to ten (very high anxiety), [31] another used a 100
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21 246 mm horizontal line with “not anxious at all” to “extremely anxious [36]” In one study, the
22
23 247 median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control
24
25 248 group ($p=0.0038$). [31] In another study, there were no significant differences between the
26
27 249 control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively,
28
29 250 $p=0.12$), and anaesthesia (20 vs. 19, respectively, $p=0.60$). [36] The median Multiple Affect
30
31 251 Adjective Check List (MAACL) score, with possible range of scores 0–21 (higher scores
32
33 252 indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in
34
35 253 the control group ($p=0.0053$). [31] The differences in the State-Trait Anxiety Index (STAI)
36
37 254 score, which comprising 40 questions rated on a 4-point Likert scale, was 1.51, 95% CI: 1.02–
38
39 255 2.02%, $p=0.0051$). [32] The results on anxiety in these two studies were significant. However,
40
41 256 Kamau *et al.* found no differences on examining anxiety and the influences of sex, duration
42
43 257 of hospital stay, and prior anaesthesia experience. [32]

51 258 *Mortality*

52
53 259 One study reported the mortality rates. [35] Patients attending the High Dependency Unit
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55 260 (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex
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3 261 orthopaedic surgery had a significant reduction in mortality rate after being assessed in the
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5 262 PAC, from 18 (6.1%) of 298 patients before to 14 (1.2%) of 1147 patients after $p=0.001$. [35]

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8 263 *Cancellation rate*

9
10 264 Four studies reported reduced cancellation rates following the establishment of a PAC.
11
12 [33,34,36,37] One of the included studies had 316 (2.0%) cancellations for medical reasons
13 265 before the introduction of PAC, and 79 (0.9%) after, and a difference of 1.02% (95% CI, 0.31–
14
15 266 1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%). [33] The overall
16
17 267 cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following surgery, and a
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19 268 difference of 0.9% (95% CI, 0.3–1.0%) when patients were assessed in PAC. [33] Mendes *et*
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21 269 *al.* [37] found a decrease in overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p\leq$
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23 270 0.05. There were 469 (number of cancellations)/10,639 (number of surgeries performed)
24
25 271 due to medical reasons in the first year of this study. The following year, a considerable
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27 272 increase above the baseline in the intervention group was observed, followed by a
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29 273 progressive decrease in the last year with 391 (number of cancellations)/10397 (number of
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31 274 surgeries performed). [37] Farasatkish *et al.* reported that of the 1,716 patients studied, 15.1
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33 275 % cancelled in the two groups. The cancellation rates in the control and intervention groups
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35 276 were 146/866 (16.8%) and 113/850 (13.29%) ($p=0.046$), respectively. The most common
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37 277 reason for cancellation was incomplete medical work-up; 51/146 (35%) in the control group
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39 278 and 32/113 (28%) in the intervention group ($p=0.03$). [34] Lee *et al.* found similar rates for
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41 279 surgery being cancelled on the scheduled date for the intervention group compared to the
42
43 280 control group (2.3% vs. 3.4%, $p=0.75$). [36]

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47 283 *Costs and willingness to pay*

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3 284 Two studies reported the costs. [35,36] One study reported a total saving of £ 486.62 per
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5 285 patient after establishing a PAC. [35] Another reported a significantly lower preoperative
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7 286 cost per patient in the intervention group compared to the control group (mean difference,
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9 \$ 463; 95% CI, -\$648 to -\$278 per patient, $p < 0.01$). [36] However, the mean difference in the
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11 287 total perioperative treatment cost was not significant, even after adjusting for cancellation
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13 288 on the day of surgery costs. [36] The intervention group patients were willing to pay (WTP)
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15 289 significantly more than the median WTP (US \$13) for a clinic consultation at the PAC than
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17 290 the control group. [36]
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23 292 *Length of stay*

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25 293 The length of stay was reported in three studies. [35-37] Mendes *et al.* [37] found a
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27 294 significant decrease in mean hospital stay of patients from 6.2 to 5.0 days ($p \leq 0.001$) during
28
29 the four years of this study. Kamal *et al.* [35] found a significant reduction in the length of
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31 295 stay in the high dependency unit from 2.1 days to 1.6 d ($p = 0.01$), and in the intensive care
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33 296 unit from 2.3 days to 1.9 days ($p = 0.01$). In the last study, no significant changes were found
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35 297 in the median duration of postoperative stay between the intervention and control groups.
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37 298 [36]
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42 300 *Organisation planning and efficiency*

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44 301 Organisation planning and efficiency have been reported in two studies. [35,37] One study
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46 302 found statistically significant changes in the reduction of unplanned admissions to the PACU
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48 303 (65/298 [22%], 111/1147 [10%], $p = 0.001$), ICU (4/298 [1.3%], 4/1147 [0.4%], $p = 0.01$), and
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50 304 HDU (4/298 [1.34%], 20/1147 [1.7%], $p = 0.01$) after implementing a PAC. [35] The planned
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52 305 admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p = 0.01$), and HDU (14/298 [4.7%],
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54 306 85/1147 [7.4%], $p = 0.1$) increased after implementing a PAC. [35] The number of PAC
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56 307 evaluations increased from year 14,704 to year 413,990 ($p \leq 0.001$). [37] The number of
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3 308 outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$), and the
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5 309 inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4), ($p \leq 0.001$). [37]
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8 310
9 311 **DISCUSSION**

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11 312 This systematic review summarises the effectiveness of PACs in improving quality and
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13 313 patient safety in general hospitals and determines the gaps in existing knowledge for future
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15 314 research. Seven studies met the inclusion criteria. Herein, we present the main results and
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17 315 infer the implications for research and practice.
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23 317 Cancellation on the day of surgery has undesirable effects on both the patients and the
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25 318 hospital system. [14] Studies have found that late patient-related cancellations could totally
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27 319 or partially be prevented, [39] if addressed during preoperative evaluations. [14,17] This is
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29 320 confirmed by only three studies in this systematic review that found a reduction in surgery
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31 321 cancellation after implementing a PAC. [33,34,37] However, Lee *et al.* found no significant
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33 322 changes between the intervention and control groups. [36] Mendes *et al.* found that the
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35 323 number of cancellations for medical reasons after PAC implementation decreased in the first
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37 324 year of implementation. In the second and third years, they were high before the number
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39 325 dropped to below baseline. [37] These conflicting findings might show that hospitals operate
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41 326 in specific contexts, with unique populations, processes, and microsystems, encountering
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43 327 unique obstacles, making implementation difficult. Patient-focused interventions should
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45 328 consider barriers, facilitators, and interrelationships between systems, staff, and
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47 329 interventions to increase the likelihood of sustainable success. [40] Addition, Kamau *et al.*
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49 330 indicated that PACs lead to more planned admissions to the ICU, HDU, and PACU, which is
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51 331 more predictable for patients, staff, and administrations. [32]
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4 333 Another finding of this systematic review was a significant reduction in the length of hospital
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7 334 stay following patients' examination in a PAC; however, a small number of studies with low
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9 335 quality were considered. Nevertheless, similar results were found in another systematic
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11 336 review claiming that perioperative systems support hospitals addressing the expected
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14 337 growth in the number and complexity of surgical procedures. [17] When patients are
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16 338 examined in the PAC and well-prepared with information, consultations, and tests, they
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18 339 need not be hospitalised until the day of surgery. A survey on operated patients showed that
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21 340 given a choice, 75% do not wish admission to the hospital until the day of operation; a major
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24 341 reason being shorter hospital stay. [41] However, an updated systematic review on the
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26 342 effectiveness of nurse-led preoperative assessment services for elective surgery found that
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29 343 the included articles demonstrated a reduced length of stay; these studies had low
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31 344 methodological quality, and therefore, the authors could not conclude that this service leads
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34 345 to reduced length of hospital stay. [18]

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38 347 The evidence from our systematic review is insufficient to conclude whether patients have
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41 348 reduced anxiety due to PAC. The included studies used different instruments for measuring
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44 349 anxiety levels, and the results could not be pooled. [42]

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48 351 A major purpose of establishing a PAC in a hospital is to better prepare the patients for the
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51 352 anticipated surgery. Healthcare professionals and policymakers are exploring strategies to
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54 353 reduce unnecessary investigations without compromising quality and patient safety. [43]
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56 354 Translation of evidence-based interventions into hospital systems can provide instant and
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58 355 substantial benefits to patients care and outcomes. However, existing literature describes
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3 356 barriers and facilitators to implementation related to the system, staff and the intervention.
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6 357 [40] "Routine preoperative laboratory tests" on relatively healthy patients are not
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8 358 recommended from the American Society of Anesthesiologist (ASA), [16] and the National
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10 359 Institute of Health and Care Excellence (NICE). [44] Instead, they encourage for patient and
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12 360 surgery- specific investigations. This recommendation is not always implemented in hospital
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14 361 protocols or practiced for several reasons. Furthermore, an observational study found that
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16 362 routine pre-operative testing to predict abnormalities found at least one abnormal test
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18 363 results in most of the relatively healthy patients. Only 0.67% of the abnormalities had
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20 364 significant impact on changing the perioperative management. [45] Blitz *et al.* argued that
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22 365 PACs should focus on early patient engagement strategies, interdisciplinary team
23
24 366 communication, detailed perioperative care plans, and patient documentation using
25
26 367 electronic health record that should be open for review by the perioperative team to
27
28 368 preserve patient information and safety. [15] Furthermore, a previous study pointed out
29
30 369 that the risk factors are not only patient-related but also organisation-related, [8] and that
31
32 370 some hospitals have perioperative care teams that are better at identifying and relieving
33
34 371 perioperative complications. [46,47] This suggests that the value of PACs lies in their ability
35
36 372 to improve the quality of the perioperative process by designing a more robust system for
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38 373 preoperative assessment and preparation. [15] A Danish study found that deaths attributed
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40 374 to anaesthesia were associated with inadequate preoperative evaluation. [7] However, the
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42 375 assessment of PAC was significantly associated with reduced mortality following complex
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44 376 orthopaedic surgery in only one study in this systematic review. [35] Retrospective studies
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46 377 have reported similar results, but with different surgeries. [15,48]
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3 380 **Strengths and limitations of the study**
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5 381 The review was performed in duplicate or independently by two researchers, and consensus
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8 382 was reached through discussion. However, grey literature, such as government and
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10 383 institutional documents, were excluded and might be a limitation of this study. Since
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12 384 organisation of healthcare systems vary in countries, the type of staff who performed the
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14 385 patient's preoperative assessment was not considered an inclusion criterion. The European
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16 386 Society of Anaesthesiology guidelines recommend that anaesthesiologists complete the
17
18 387 preoperative assessment, while trained nurses or anaesthesia trainees perform the
19
20 388 screening. [8] A preoperative evaluation performed by an internist was associated with
21
22 389 increased length of stay and increased postoperative mortality. [49] This systematic review
23
24 390 results were possibly affected by the heterogeneity in the types of staff performing the
25
26 391 preoperative assessment.
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34 393 We exclusively included studies with high internal validity. Therefore, we excluded several
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36 394 retrospective studies. Nonetheless, remaining studies' risk of bias was fairly high, and were
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38 395 heterogeneous and meta-analyses were not statistically appropriate. [27] The included
39
40 396 studies' designs could not rule out selection bias and confounding, and the strength of the
41
42 397 evidence should be assessed cautiously. Many studies did not make adjustments for several
43
44 398 confounders, which could be responsible for the observed effects. Several studies lacked
45
46 399 descriptions of the methods used and the patients included, lowering transparency. It is not
47
48 400 very reassuring that many such studies were unable to deliver more thorough evidence to
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50 401 guide practice and should be assessed cautiously. The results are relevant to health care
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52 402 services, focusing on the well-being and safety of the patients.
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404 **Implications for future research and practice**

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

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

416 **CONCLUSION**

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

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426 the search strategy and removal of duplicates.

427 **Competing Interests**

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3 428 The authors declare that they have no conflict of interest.
4

5 429 **Data sharing statement**
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7
8 430 All data relevant to the study are included within the article or have been uploaded within
9
10 431 supplemental files.
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12
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14

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16
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18

19
20 435 **Author contributions**
21

22 436 EWK, MF, AO and TOT: Study design
23

24
25 437 EWK, MF, AO: Search and screening of the articles
26

27 438 EWK: Data extraction
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29
30 439 MF, AO, RCB and TOT: Control of data extraction
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32 440 EWK, MF, AO and RCB: Quality assessment of the included articles
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34
35 441 EWK: Drafting of the manuscript
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37 442 MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript
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39
40 443 MF, AO, RCB and TOT: Supervised the study
41

42 444 **References**
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6 599
7 600 **Figure legends**

8 601
9 602 Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). [24]
10 603

11 604 Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental
12 605 studies was used for the risk of bias assessment. [30]
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For peer review only



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Identification

Records identified through
database searching
(n=2981)

(Embase n=1572, Cinahl n=209,
Medline n=1200)

Screening

Duplicates removed
(n=923)

Title and abstract screened
(n=2058)

Records excluded
(n=1879)

Eligibility

Full-text articles assessed
for eligibility
(n=179)

Full-text articles excluded,
with reasons
(n=173)

- 82 wrong study design
- 27 not a preoperative anaesthesia clinic
- 23 not a research paper
- 18 abstract/conference/ editorial letter
- 15 wrong interventions/ setting
- 2 full text not available
- 4 duplicates
- 2 wrong languages

Studies included in
systematic review
(n=6)

Included

Additional searching in
references (=1)

Studies included in
systematic review
(n=7)

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

	Are cause and effect clear?	Are comparison participants similar?	Did comparison participants have similar care?	Was there a control group?	Were there multiple pre post measurements?	Was follow-up complete?	Were outcomes measured the same way?	Were outcomes measured in reliable way?	Was appropriate stat analysis used?
Farasatkish 2009	+	+	?	+	-	?	+	+	+
Kamal 2011	+	?	?	+	-	?	?	?	?
Kamau 2017	+	+	-	+	-	+	+	+	+
Klopfenstein 2000	+	-	+	+	-	?	+	+	+
Lee 2012	+	+	-	+	-	?	+	+	+
Mendes 2005	+	?	?	+	-	?	?	?	+
van Klei 2002	+	+	-	+	-	?	+	+	+

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

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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

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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*)).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*)).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 remove duplicates from 9

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21 *Database: Cinahl Plus with Full Text (EBSCOhost)*

22
23 Results: n=132

24 Search:

25 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
26 measurement* or evaluat*))
27 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
28 3 S1 AND S2
29 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
30 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
31 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
32 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
33 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
34 or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
35 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
36 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
37 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
38 assessment* or measurement*)
39 8 S3 OR S4 OR S5 OR S6 OR S7
40 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-
41 20181231; Exclude MEDLINE records
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46 3. Search update, 3 February 2020

47 3.1. Main Databases

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49
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51 *Database: Embase (Ovid)*

52
53 Results: n=1453

54 Search:

55 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
56 measurement* or evaluat*)).ti.
57 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
58 3 1 and 2
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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*)).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*)).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 limit 9 to (conference abstracts or embase)

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22 *Database: Medline (Ovid)*

23
24 Results: n=1105

25 Search:

26 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
27 measurement* or evaluat*)).ti.
28 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
29 3 1 and 2
30 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
31 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
32 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
33 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
34 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
35 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
36 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
37 anesthe*)).ti,ab.
38 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
39 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
40 assessment* or measurement*)).ti,ab.
41 8 or/3-7
42 9 limit 8 to yr="1996 -Current"

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47 *Database: Cinahl Plus with Full Text (EBSCO host)*

48
49 Results: n=166

50 Search:

51 1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
52 measurement* or evaluat*))
53 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
54 3 S1 AND S2
55 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
56 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
57 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
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5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
 6 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
 7 or anaesthe* or aneste* or preoperativ* or "pre operativ*" pre-operativ* or
 8 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
 9 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23
 10 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evalu* or assessment*
 11 or measurement*)
 12 7 S3 OR S4 OR S5 OR S6 OR S7 487
 13 8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;
 14 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 aneste* 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 (evalu* 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*
 6 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
 7 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
 8 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
 9 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
 8 assessment* or measurement*).ti,ab. (4)

8 or/3-7

9 limit 8 to yr="1996 -Current"

16 *Database: Cinahl Plus with Full Text (EBSCO host)*

18 Results: n=209

19 Search:

20 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
 21 measurement* or evaluat*))

22 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)

23 3 S1 AND S2

24 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
 25 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
 26 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

27 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat*
 28 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND
 29 (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
 30 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")

31 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30

32 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
 33 assessment* or measurement*)

34 8 S3 OR S4 OR S5 OR S6 OR S7

35 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;

36 Exclude MEDLINE records

Reporting checklist for systematic review and meta-analysis.

Based on the PRISMA guidelines.

Instructions to authors

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	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

1	Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
2				
3				
4				
5				
6	Methods			
7				
8				
9	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
10				
11				
12				
13				
14	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
15				
16				
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20				
21	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
22				
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28	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
29				
30				
31				
32				
33	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
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39				
40	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
41				
42				
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45				
46	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
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52	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
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1	Summary	#13	State the principal summary measures (e.g., risk ratio,	N/A
2	measures		difference in means).	
3				
4	Planned	#14	Describe the methods of handling data and combining	7
5	methods of		results of studies, if done, including measures of	
6	analysis		consistency (e.g., I ²) for each meta-analysis.	
7				
8	Risk of bias	#15	Specify any assessment of risk of bias that may affect the	12
9	across studies		cumulative evidence (e.g., publication bias, selective	
10			reporting within studies).	
11				
12	Additional	#16	Describe methods of additional analyses (e.g., sensitivity or	N/A
13	analyses		subgroup analyses, meta-regression), if done, indicating	
14			which were pre-specified.	
15				
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21	Results			
22				
23	Study selection	#17	Give numbers of studies screened, assessed for eligibility,	8
24			and included in the review, with reasons for exclusions at	
25			each stage, ideally with a flow diagram .	
26				
27				
28	Study	#18	For each study, present characteristics for which data were	N/A
29	characteristics		extracted (e.g., study size, PICOS, follow-up period) and	
30			provide the citation.	
31				
32				
33				
34	Risk of bias	#19	Present data on risk of bias of each study and, if available,	12 + Figure
35	within studies		any outcome-level assessment (see Item 12).	
36				
37				
38	Results of	#20	For all outcomes considered (benefits and harms), present,	12-16
39	individual studies		for each study: (a) simple summary data for each	
40			intervention group and (b) effect estimates and confidence	
41			intervals, ideally with a forest plot.	
42				
43				
44	Synthesis of	#21	Present the main results of the review. If meta-analyses are	12-16
45	results		done, include for each, confidence intervals and measures	
46			of consistency.	
47				
48				
49				
50	Risk of bias	#22	Present results of any assessment of risk of bias across	N/A
51	across studies		studies (see Item 15).	
52				
53				
54	Additional	#23	Give results of additional analyses, if done (e.g., sensitivity	N/A
55	analysis		or subgroup analyses, meta-regression [see Item 16]).	
56				

Discussion

1	Summary of	#24	Summarize the main findings, including the strength of	16-19
2	Evidence		evidence for each main outcome; consider their relevance	
3			to key groups (e.g., health care providers, users, and policy	
4			makers	
5				
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7				
8	Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of	19
9			bias), and at review level (e.g., incomplete retrieval of	
10			identified research, reporting bias).	
11				
12				
13	Conclusions	#26	Provide a general interpretation of the results in the context	20
14			of other evidence, and implications for future research.	
15				
16				
17	Funding			
18				
19	Funding	#27	Describe sources of funding or other support (e.g., supply	21
20			of data) for the systematic review; role of funders for the	
21			systematic review.	
22				
23				

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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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3 1 **Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and**
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5 2 **non-randomised prospective controlled studies**
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10 4 Eirunn Wallevik Kristoffersen^{1,2} *, Anne Opsal¹, Tor Oddbjørn Tveit^{1,2,3}, Rigmor C Berg^{4,5},
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12 5 Mariann Fossum¹
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50 20
51 21 Word count: 4156
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1
2
3 24 **ABSTRACT**

4
5 25 **Objectives:** The aim of this systematic review was to examine the effectiveness of pre-
6
7 26 anaesthesia assessment clinics (PACs) in improving the quality and safety of perioperative
8
9 27 patient care.

10
11 28 **Design:** Systematic review.

12
13 29 **Data sources:** The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline,
14
15 30 and Embase (OvidSP) were systematically searched on 11 September 2018
16
17 31 and updated on 3 February 2020 and 4 February 2021.

18
19 32 **Eligibility criteria:** The inclusion criteria for this study were studies published in English or
20
21 33 Scandinavian language and scientific original research that included randomised or non-
22
23 34 randomised prospective controlled studies. Additionally, studies that reported the outcomes
24
25 35 from a PAC consultation with the patient present were included.

26
27 36 **Data extraction and synthesis:** Titles, abstracts, and full texts were screened by a team of
28
29 37 three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal
30
31 38 checklist for quasi-experimental studies. Data extraction was performed by one author and
32
33 39 checked by four other authors. Results were synthesised narratively owing to the
40
41 40 heterogeneity of the included studies.

34
35 41 **Results:** Seven prospective controlled studies on the effectiveness of PACs, were included.
36
37 42 Three studies reported a significant reduction in the length of hospital stay and two studies
38
39 43 reported a significant reduction in cancellation of surgery for medical reasons when patients
40
41 44 were seen in the PAC. In addition, the included studies presented mixed results regarding
42
43 45 anxiety in patients. Most studies had a high risk of bias.

44
45 46 **Conclusion:** This systematic review demonstrated a reduction in the length of hospital stay
46
47 47 and cancellation of surgery when the patients had been assessed in the PAC. There is a need
48
49 48 for high-quality prospective studies to gain a deeper understanding of the effectiveness of
50
51 49 PACs.

52
53 50 **PROSPERO registration number:** CRD42019137724
54
55 51

56
57 52 **Keywords:** pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic
58
59 53 review
60
61 54
62 55

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

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2
3 84 6:00 PM.[7] This might indicate that risk factors are both patient- and surgery-related and
4
5 85 may be linked to organisational structures.[8]
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9 86 Currently, an increasing number of pre-anaesthesia assessment clinics (PACs) support
10
11 87 hospitals internationally in handling the rising number of patients and complexity of surgical
12
13 88 procedures.[9] The design of PACs differs critically based on location, organisational
14
15 89 structure, timing, and patient groups. They primarily function as a service unit for surgeons,
16
17 90 patients, and the anaesthetic team.[10] The PAC consultation, by the anaesthesiologist,
18
19 91 anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the
20
21 92 patients' medical condition prior to surgery and anaesthesia.[2] Thus, it is essential for
22
23 93 secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk
24
25 94 patients, improves patient outcomes, prepares the patient physically and psychologically for
26
27 95 anaesthesia, and ensures the patient's most favourable condition for surgery and
28
29 96 anaesthesia.[11-13] This is primarily performed by interviewing and examining the patient;
30
31 97 reviewing previous medical, surgical and anaesthesia issues; evaluating current medication;
32
33 98 and obtaining and reviewing preoperative tests.[10] PACs also allow increased
34
35 99 communication between healthcare providers and coordination with postoperative
36
37 100 care.[14,15] Because of well-prepared patients and staff, several researchers have indicated
38
39 101 that with PAC, the number of surgical cancellations, length of hospital stay, laboratory tests,
40
41 102 and mortality rate have reduced.[7,16,17] Others assert that patients feel less anxious
42
43 103 regarding the subsequent anaesthetic and surgical processes and are highly satisfied with
44
45 104 the service with PAC consultations.[16,18,19]
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56 105 As Turunen *et al.* stated, research on PACs regarding costs, financial savings, the impact on
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58 106 patient safety and quality of care, accuracy of the number of operative patients, and effect
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1
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3 107 on preoperative nursing levels, is scarce.[20] Survey results indicate that anaesthesiologists
4
5 108 perceive day of surgery delays due to missing information as common, even with PAC
6
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8 109 consultations.[21] This systematic review aimed to examine the effectiveness of PACs in
9
10 110 improving the quality and safety of perioperative patient care. Further, we aimed to
11
12 111 determine the gaps in existing knowledge for future research.
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14
15

16 112 **METHODS**

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18
19 113 Our systematic review followed the guidelines in the Cochrane Handbook for Systematic
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21 114 Reviews of Interventions[22] and was reported in accordance with the Preferred Reporting
22
23 115 Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[23] The protocol was
24
25 116 registered in PROSPERO: CRD42019137724.[24]
26
27

28
29 117 The two review questions were:

- 30
31 118 1. Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?
32
33 119 2. Is PAC effective in reducing cancellation rate and cost of surgery, and improving the
34
35 120 efficiency of perioperative patient care?
36
37
38

39 121 **Search strategies**

40
41
42 122 We performed a scoping search in different databases to identify the key terms.[25,26] The
43
44 123 final search was planned and conducted in close collaboration with the university librarian.
45
46

47 124 On 11 September 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and
48
49 125 Embase (OvidSP) databases, which were updated on 3 February 2020 and 4 February 2021.
50
51

52 126 Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words, such
53
54 127 as 'pre-anaesthesia', 'nurse', 'surgery', 'anaesthesia', 'preoperative', 'assessment',
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56 128 'measurement', 'evaluate', 'preadmission', 'centre', 'clinic', 'ward', 'unit', and 'outpatient'.
57
58

59 129 The searches are detailed in Appendix 1. The search mode in CINAHL was Boolean/Phase,
60

1
2
3 130 which supports Boolean searching or exact phrase searching. For comprehensiveness, we
4
5
6 131 used both the truncation and proximity operators. We limited the search to 1996, the year
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8 132 one of the first known articles in this area was published.[27] Complementary methods to
9
10 133 identify studies included following up on citations via Scopus, scanning the reference lists of
11
12
13 134 relevant papers and included articles, and checking for relevant studies in clinical trials.[25]

15 135 **Eligibility criteria**

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18 136 The main inclusion criterion was that the study, using empirical quantitative methods,
19
20 137 addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English
21
22
23 138 or Scandinavian language, (b) scientific publication of original research, (c) reported the
24
25 139 outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-
26
27
28 140 randomised prospective controlled studies, and (f) newly established PAC. The following
29
30 141 were excluded: (a) editorials, discussions, and conference abstracts, (b) reviews, (c)
31
32
33 142 instrument testing, (d) studies on children, and (e) retrospective studies.

35 143 **Study selection**

37
38 144 All references identified in the search were transferred to EndNoteX9, where the duplicates
39
40 145 were removed. Subsequently, all unique references were transferred to the Covidence
41
42 146 screening tool.[28] Study eligibility was ascertained independently, first at the title and
43
44
45 147 abstract level, and subsequently at the full text level. Three of the authors screened all the
46
47 148 articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were
48
49
50 149 resolved by consulting two other authors (RCB and TOT).

52 150 **Quality assessment**

54
55 151 Risk of bias in studies were assessed using design-specific checklists. Given the
56
57 152 methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal
58
59 153 checklist for quasi-experimental studies was used.[29] Author EWK performed the risk of

1
2
3 154 bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through
4
5 155 discussion with MF and AO. Each of the nine checklist questions was answered no, yes,
6
7
8 156 unclear, or not applicable.
9

10 157 **Data extraction and analysis**

11
12
13 158 Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the
14
15 159 authors confirmed the accuracy, consistency, and completeness of the extracted data that
16
17 160 included publication details; study design; setting; and characteristics of the patients,
18
19 161 interventions, comparisons, and outcome (PICO). We requested information on the missing
20
21 162 data; however, received no response from the authors. If the PICO elements had been
22
23 163 sufficiently similar and statistical data were available, we had intended to conduct a meta-
24
25 164 analysis. However, the extracted data revealed substantial heterogeneity. Therefore, we
26
27 165 performed a narrative synthesis. We described the findings in text, stratified by outcome,
28
29 166 with descriptions of the effects of interventions for each study, classification of the effect
30
31 167 direction, and we looked across contributing studies to develop a summary of findings for
32
33 168 each outcome.[22]
34
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40 169 **Patient and Public Involvement**

41
42 170 Patients and/or the public were not involved in the design, conduct, reporting, or
43
44 171 dissemination plans of this research. However, the project was initiated by health
45
46 172 professionals.
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48
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50 173

51 174 **RESULTS**

52
53
54 175 Figure 1. provides the details of the study selection process. A total of 2,981 records were
55
56 176 identified in the final search (2021). After removing duplicates, we screened 2,058 records
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58
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1
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3 177 based on the title and abstract; 179 records passed the full-text screening. After applying the
4
5 178 inclusion criteria, seven studies were selected for the final analysis.

7
8 179 **Overall characteristics of the studies**

9
10 180 The seven studies are listed in Table 1. All seven studies were in English and were published
11
12
13 181 between 2000 and 2017, with data collected between 1997 and 2015 (one study did not
14
15 182 report data collection information).[30] Based on the inclusion criteria, all were prospective
16
17
18 183 controlled studies; however, no RCTs were found. There was one controlled before-after
19
20 184 study.[31] The remaining six studies had control groups; assessments followed PAC
21
22
23 185 implementation, without baseline assessments. There were three two-group non-parallel
24
25 186 after-only studies,[32-34] and three two-group parallel after-only studies;[30] one had a
26
27
28 187 matched control group[35] and one had three follow-up assessments of one arm.[36] One
29
30 188 study had only cancellation rate as prospective data.[32] The studies included 77,411
31
32
33 189 patients.

190 **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

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

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3 194 Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and
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6 195 control groups, respectively. One study did not specify the number of patients in the
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8 196 intervention and control groups, but only the total number of surgeries performed.[36] Five
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10 197 studies reported data for sex, showing that 51% of the patients were women and 49% were
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12 198 men (12,129 vs. 11,583).[30-33,35] There were more women than men in both the
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15 199 intervention (4,345 vs. 4,134) and control groups (7,784 vs. 7,449). Five studies reported
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17 200 data for age showing that all patients were over 20 years of age[30-33,35] and four studies
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19 201 had grouped within the American Society of Anesthesiology (ASA) category.[30,33-35]
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24 203 The patients were scheduled to undergo a variety of surgeries, including
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26 204 orthopaedic,[31,32,34,35] urology,[30-32,35] general,[31,32,35] heart,[33]
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28 205 gynaecology/obstetrics,[31,32,35] vascular surgery,[32] ophthalmology,[32]
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30 206 maxillofacial/dental surgery,[31,32] and neurological surgery,[32] while one did not specify
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32 207 the type.[36] In five studies, the type of anaesthesia was not specified,[31-34,36] and two
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34 208 studies reported patients for general and/or regional supplement.[30,35]
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39 210 The patients included had previous anaesthetic experience in one study,[30] previous and no
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41 211 previous anaesthetic experience in another,[31] and five studies did not report this data.[32-
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43 212 36] Limited background characteristics of the patients were reported in two studies.[34,36]
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45 213 One stated that the patients included had ASA 3 or 4 and a body mass index >40; however,
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47 214 no ASA number, sex, or age was reported.[34] Mendes *et al.* did not report any background
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49 215 characteristics of the included patients.[36]
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3 217 Considering the intervention, the PACs in all studies comprised an outpatient service
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5 218 whereby patients were examined for medical conditions important for anaesthesia and
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8 219 informed regarding expectations on the day of surgery. Nevertheless, the terminology used
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10 220 for PACs varied, as they served different surgical specialities and conducted pre-anaesthesia
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13 221 consultation from ≥ 48 h to ≤ 3 months before the surgery. The settings included a university
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15 222 hospital (n=3),[31,35,36] teaching hospital (n=1),[32] medical centre (n=1),[33] and general
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17 223 hospital (n=1);[34] one study did not specify the context.[30] The staff conducting the pre-
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19 224 anaesthetic consultation also varied: in five studies, it was the anaesthesiologists,[30,32,34-
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21 225 36] in the other studies, it was (also) the orthopaedic senior house officer,[34] consultant or
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23 226 resident,[31] or physician.[33] In three studies, nurses were part of the team.[32,34,35] The
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25 227 comparison in all studies was usual care, which generally involved a preoperative
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27 228 anaesthetic evaluation of the admitted patients the day before the surgery.

229 **Description of risk of bias in the studies**

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

234 **Outcomes of the included studies**

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

236 *Satisfaction*

237 One study reported satisfaction as an outcome.[35] The summarised patient satisfaction
238 with the anaesthetic consultation score out of 100 showed that the patients in the PAC
239 group were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–
240 3.70%; $p=0.01$).[35] There was no statistically significant difference between the two groups

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3 241 in mean patient satisfaction with perioperative anaesthesia care score after surgery (mean
4
5 242 difference 0.01%, $p=0.94$).[35] The quality of recovery (QoR) measure referred to the
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7 243 patients' quality of recovery score.[37] The mean QoR score (range, 0–18) following
8
9 244 anaesthesia on the first day after surgery was similar between the intervention (13.17 ± 2.73)
10
11 245 and control (13.31 ± 2.65) groups ($p=0.67$).[35]

15 246 *Anxiety*

17 247 Three studies reported anxiety.[30,31,35] Two studies reported the visual analogue scale
18
19 248 (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[30] another used a 100-
20
21 249 mm horizontal line with 'not anxious at all' to 'extremely anxious'.[35] In one study, the
22
23 250 median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control
24
25 251 group ($p=0.0038$).[30] In another study, there were no significant differences between the
26
27 252 control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively,
28
29 253 $p=0.12$), and anaesthesia (20 vs. 19, respectively, $p=0.60$).[35] The median Multiple Affect
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31 254 Adjective Check List (MAACL) score, with possible range of scores from 0 to 21 (higher scores
32
33 255 indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in
34
35 256 the control group ($p=0.0053$).[30] The differences in the State-Trait Anxiety Index (STAI)
36
37 257 score, which comprised 40 questions rated on a four-point Likert scale, was 1.51 (95% CI:
38
39 258 1.02–2.02%, $p=0.0051$).[31] The results on anxiety in these two studies were significant.
40
41 259 However, Kamau *et al.* found no differences on examining anxiety and the influences of sex,
42
43 260 duration of hospital stay, and prior anaesthesia experience.[31]

51 261 *Mortality*

52 262 One study reported the mortality rates.[34] Patients attending the High Dependency Unit
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54 263 (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex
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3 264 orthopaedic surgery had a significant reduction in mortality rate after being assessed at the
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5 265 PAC, from 18 (6.1%) of 298 patients to 14 (1.2%) of 1147 patients ($p=0.001$).[34]
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8 266 *Cancellation rate*

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10 267 Four studies reported reduced cancellation rates following the establishment of a
11
12 268 PAC.[32,33,35,36] One of the included studies had 316 (2.0%) cancellations for medical
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14 269 reasons before the introduction of PAC, and 79 (0.9%) after, with a difference of 1.02% (95%
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16 270 CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%).[32] The overall
17
18 271 cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following PAC introduction,
19
20 272 with a difference of 0.9% (95% CI, 0.3–1.0%).[32] Mendes *et al.*[36] found a decrease in
21
22 273 overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. In the first year of their
23
24 274 study, there were 469 cancellations per 10,639 surgeries performed. The following year, a
25
26 275 considerable increase above the baseline in the intervention group was observed, followed
27
28 276 by a progressive decrease in the last year with 391 cancellations per 10,397 surgeries
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30 277 performed.[36] Farasatkish *et al.* reported that of the 1,716 patients studied, a mean of 15.1
31
32 278 % cancelled in the two groups. The cancellation rates in the control and intervention groups
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34 279 were 16.8% (146 [number of cancellations]/866 [number of surgeries]) and 13.29%
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36 280 (113/850) ($p=0.046$), respectively. The most common reason for cancellation was
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38 281 incomplete medical work-up; 51/146 (35%) in the control group and 32/113 (28%) in the
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40 282 intervention group ($p=0.03$).[33] Lee *et al.* found similar rates for surgery being cancelled on
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42 283 the scheduled date for the intervention group compared with the control group (2.3% vs.
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44 284 3.4%, $p=0.75$).[35]
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57 286 *Costs and willingness to pay*

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3 287 Two studies reported the costs.[34,35] One study reported a total saving of £ 486.62 per
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6 288 patient after establishing a PAC.[34] Another reported a significantly lower preoperative cost
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8 289 per patient in the intervention group compared with that of the control group (mean
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10 290 difference, \$ 463; 95% CI, -\$648 to -\$278 per patient, $p < 0.01$).[35] However, the mean
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13 291 difference in the total perioperative treatment cost was not significant, even after adjusting
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15 292 for cancellation on the day of surgery costs.[35] Compared to the control group, the
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18 293 willingness to pay (WTP) among the intervention group patients was significantly more than
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20 294 the median WTP (US \$13) for a clinic consultation at the PAC.[35]

22 295 *Length of stay*

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25 296 The length of stay was reported in three studies.[34-36] Mendes *et al.*[36] found a significant
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27 297 decrease in mean hospital stay of patients from 6.2 to 5.0 days ($p \leq 0.001$) during the 4 years
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30 298 of this study. Kamal *et al.*[34] found a significant reduction in the length of stay in the HDU
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32 299 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
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35 300 last study, no significant changes were found in the median duration of postoperative stay
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37 301 between the intervention and control groups.[35]

39 302 *Organisation planning and efficiency*

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42 303 Organisation planning and efficiency have been reported in two studies.[34,36] One study
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44 304 found statistically significant changes in the reduction of unplanned admissions to the PACU
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46 305 (65/298 [22%], 111/1147 [10%], $p = 0.001$), ICU (4/298 [1.3%], 4/1147 [0.4%], $p = 0.01$), and
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49 306 HDU (4/298 [1.34%], 20/1147 [1.7%], $p = 0.01$) after implementing a PAC.[34] The planned
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52 307 admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p = 0.01$), and HDU (14/298 [4.7%],
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54 308 85/1147 [7.4%], $p = 0.1$) increased after implementing a PAC.[34] The number of PAC
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57 309 evaluations increased from 14,704 (year 1) to 413,990 (year 4) ($p \leq 0.001$).[36] The number
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3 310 of outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$) and the
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5 311 inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4) ($p \leq 0.001$).[36]
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8 312
9 313 **DISCUSSION**

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11 314 This systematic review summarises the effectiveness of PACs in improving quality and safety
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14 315 of pre-anaesthetic patient care in general hospitals and determines the gaps in existing
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16 316 knowledge for future research. Herein, we present the main results of the review and infer
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19 317 the implications for research and practice.
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24 319 Seven studies met the inclusion criteria, and the main findings were reduction in the length
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26 320 of stay and surgery cancellation rate in hospitals. However, the studies were of low quality,
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29 321 making it difficult to draw any conclusion. The evidence from our systematic review is
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31 322 insufficient to conclude whether patients have reduced anxiety because of PAC. This is
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33 323 because the included studies used different instruments for measuring anxiety levels, and
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36 324 the results could not be pooled.[38]
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41 326 A major purpose of establishing a PAC in a hospital is to better prepare the patients for the
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43 327 anticipated surgery. Healthcare professionals and policymakers are exploring strategies to
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46 328 reduce unnecessary investigations without compromising quality of care and patient
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48 329 safety.[39] Transition of evidence-based interventions to the hospital systems can provide
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51 330 substantial benefits to patient care.[40] According to the ASA and the National Institute of
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53 331 Health and Care Excellence, routine preoperative laboratory tests are not recommended for
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56 332 relatively healthy patients. Instead, they encourage patient and surgery- specific
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58 333 investigations.[15,40] This recommendation is not always implemented in hospital protocols
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3 334 or practice. An observational study showed that routine preoperative testing to predict
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5 335 abnormalities found at least one abnormal test result in most of the relatively healthy
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8 336 patients. Only 0.67% of the abnormalities had a significant impact on changing the
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10 337 perioperative management.[41] Blitz *et al.* argued that PACs should focus on early patient
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12 338 engagement strategies, interdisciplinary team communication, detailed perioperative care
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14 339 plans, and patient documentation using electronic health record, which should be open for
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16 340 review by the perioperative team.[14] Furthermore, a previous study mentioned that the
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18 341 risk factors are not only patient-related but also organisation-related,[7] and that some
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20 342 hospitals have perioperative care teams that are better at identifying and relieving
21
22 343 perioperative complications.[42,43] Thus, the value of PACs lies in their ability to improve
23
24 344 the quality of the perioperative process by designing a more robust system for preoperative
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26 345 assessment and preparation.[14] A narrative review found higher rates of morbidity and
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28 346 mortality in non-operating room anaesthesia, and one of the main reasons was limited
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30 347 preoperative evaluation.[6] In this systematic review, the assessment of PAC was
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32 348 significantly associated with reduced mortality following complex orthopaedic surgery in
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34 349 only one study.[34] Retrospective studies have reported similar results, but with different
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36 350 surgeries.[14,44]

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46 352 Cancellation on the day of surgery has undesirable effects on both the patients and the
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48 353 hospital system.[13] Late patient-related cancellations can totally or partially be
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50 354 prevented,[45] if addressed during preoperative evaluations.[16] This has been confirmed by
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52 355 only three studies in this systematic review that found a reduction in surgery cancellation
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54 356 after implementing a PAC.[32,33,36] However, Lee *et al.* found no significant changes
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56 357 between the intervention and control groups.[35] Mendes *et al.* found that the number of
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3 358 cancellations for medical reasons after PAC implementation decreased in the first year of
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6 359 implementation. In the second and third years, they were high before the number dropped
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8 360 to below baseline.[36] These conflicting findings indicate that hospitals operate in specific
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10 361 contexts, with unique populations, processes, and microsystems, encountering unique
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13 362 obstacles, making implementation difficult. Patient-focused interventions should consider
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15 363 barriers, facilitators, and interrelationships between systems, staff, and interventions to
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18 364 increase the likelihood of sustainable success.[46] Additionally, Kamal *et al.* indicated that
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20 365 PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more
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23 366 predictable for patients, staff, and administration.[34]
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27 368 Another finding of this review was a significant reduction in the length of hospital stay
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30 369 following patients' examination in a PAC; however, a small number of studies with low
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33 370 quality were considered. Nevertheless, similar results were found in another systematic
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35 371 review claiming that perioperative systems support the hospitals by addressing the expected
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37 372 growth in the number and complexity of surgical procedures.[16] When patients are
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40 373 examined in the PAC and well-prepared with information, consultations, and tests, they
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42 374 need not be hospitalised until the day of surgery. A survey on operated patients showed that
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45 375 given a choice, 75% do not wish admission to the hospital until the day of operation; a major
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47 376 reason being shorter hospital stay.[47] An updated systematic review on the effectiveness of
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50 377 nurse-led preoperative assessment services for elective surgery found that the included
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52 378 articles demonstrated a reduced length of stay; these studies had low methodological
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55 379 quality, and therefore, the authors could not conclude that this service leads to reduced
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57 380 length of hospital stay.[17]
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382 **Strengths and limitations of the study**

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

394
395 We exclusively included studies with high internal validity. Therefore, several retrospective
396 studies were excluded. Nonetheless, as the remaining studies' risk of bias was fairly high,
397 and they were heterogeneous, a meta-analysis was not statistically appropriate.[26] The
398 included studies' designs could not rule out selection bias and confounders; thus, the
399 strength of the evidence should be assessed cautiously. Many studies did not adjust for
400 several confounders, which could be responsible for the observed effects. Several studies
401 lacked descriptions of the methods used and the patients included, lowering transparency.
402 The results are relevant to health care services, focusing on the well-being and safety of the
403 patients.

405 **Implications for future research and practice**

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3 406 This systematic review identified the ambiguity in the PAC interventions offered to the
4
5 407 intervention group. In many studies, it was evident that the methods used lacked clarity, and
6
7 408 high-quality research is needed in this field. The included studies did not demonstrate earlier
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9 409 surgical room entry time[49,50] or reduction in the number of preoperative tests for
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11 410 patients attending the PAC, similar to the results of the retrospective studies.[27]
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13 411 Other implications may include the organisation structure of different PACs and their
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15 412 functioning. Additionally, the tests that should be part of the assessment at the PACs should
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17 413 be investigated. The use of technology, such as streaming services, facilitates different
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19 414 patient groups and might become crucial for reducing human contact and spread of
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21 415 infection in context of coronavirus disease 2019.
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28 416 **CONCLUSION**

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30 417 PAC use has reduced the length of stay and surgery cancellation rate at hospitals. However,
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32 418 the effectiveness of PAC, the major review question, remains unclear, and requires further
33
34 419 research. There is a demand for high-quality studies capturing robust data describing the
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36 420 quality of care and clinical outcomes for patients requiring anaesthesia. This requires
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38 421 increased focus and funding for this specific area of health services research and could,
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40 422 therefore, lead to implementation of PACs in health care services and improve patient safety
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42 423 and perioperative care.
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48
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50
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52
53

54 427 **Competing Interests**

55
56 428 The authors declare that they have no conflict of interest.
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59 429 **Data sharing statement**

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3 430 All data relevant to the study are included within the article or have been uploaded within
4
5 431 supplemental files.

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13
14
15 435 **Author contributions**

16
17 436 EWK, MF, AO, and TOT: Study design

18
19 437 EWK, MF, AO: Search and screening of the articles

20
21 438 EWK: Data extraction

22
23 439 MF, AO, RCB, and TOT: Control of data extraction

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25 440 EWK, MF, AO, and RCB: Quality assessment of the included articles

26
27 441 EWK: Drafting of the manuscript

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29 442 MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript

30
31 443 MF, AO, RCB, and TOT: Supervised the study

32
33 444 **References**

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596 **Figure legends**

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

599 [23]

600 Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental

601 studies was used for the risk of bias assessment. [29]

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For peer review only



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Identification

Records identified through
database searching
(n=2981)

(Embase n=1572, Cinahl n=209,
Medline n=1200)

Screening

Duplicates removed
(n=923)

Title and abstract screened
(n=2058)

Records excluded
(n=1879)

Eligibility

Full-text articles assessed
for eligibility
(n=179)

Full-text articles excluded,
with reasons
(n=173)

- 82 wrong study design
- 27 not a preoperative anaesthesia clinic
- 23 not a research paper
- 18 abstract/conference/ editorial letter
- 15 wrong interventions/ setting
- 2 full text not available
- 4 duplicates
- 2 wrong languages

Studies included in
systematic review
(n=6)

Included

Additional searching in
references (=1)

Studies included in
systematic review
(n=7)

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

	Are cause and effect clear?	Are comparison participants similar?	Did comparison participants have similar care?	Was there a control group?	Were there multiple pre post measurements?	Was follow-up complete?	Were outcomes measured the same way?	Were outcomes measured in reliable way?	Was appropriate stat analysis used?
Farasatkish 2009	+	+	?	+	-	?	+	+	+
Kamal 2011	+	?	?	+	-	?	?	?	?
Kamau 2017	+	+	-	+	-	+	+	+	+
Klopfenstein 2000	+	-	+	+	-	?	+	+	+
Lee 2012	+	+	-	+	-	?	+	+	+
Mendes 2005	+	?	?	+	-	?	?	?	+
van Klei 2002	+	+	-	+	-	?	+	+	+

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

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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

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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*)).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*)).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 remove duplicates from 9

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21 *Database: Cinahl Plus with Full Text (EBSCOhost)*

22
23 Results: n=132

24 Search:

25 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
26 measurement* or evaluat*))
27 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
28 3 S1 AND S2
29 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
30 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
31 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
32 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
33 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
34 or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
35 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
36 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
37 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
38 assessment* or measurement*)
39 8 S3 OR S4 OR S5 OR S6 OR S7
40 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-
41 20181231; Exclude MEDLINE records
42
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46 3. Search update, 3 February 2020

47 3.1. Main Databases

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49
50
51 *Database: Embase (Ovid)*

52
53 Results: n=1453

54 Search:

55 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
56 measurement* or evaluat*)).ti.
57 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
58 3 1 and 2
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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 limit 9 to (conference abstracts or embase)

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21
22 *Database: Medline (Ovid)*

23
24 Results: n=1105

25 Search:

26 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
27 measurement* or evaluat*).ti.
28 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
29 3 1 and 2
30 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
31 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
32 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*).ti,ab.
33 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
34 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
35 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
36 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
37 anesthe*).ti,ab.
38 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
39 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
40 assessment* or measurement*).ti,ab.
41 8 or/3-7
42 9 limit 8 to yr="1996 -Current"

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47 *Database: Cinahl Plus with Full Text (EBSCO host)*

48 Results: n=166

49 Search:

50 1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
51 measurement* or evaluat*))
52 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
53 3 S1 AND S2
54 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
55 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
56 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
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5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
 6 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
 7 or anaesthe* or aneste* or preoperativ* or "pre operativ*" pre-operativ* or
 8 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
 9 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23
 10 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evalu* or assessment*
 11 or measurement*)
 12 7 S3 OR S4 OR S5 OR S6 OR S7 487
 13 8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;
 14 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 aneste* 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 (evalu* 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*
 6 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
 7 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
 8 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
 9 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
 8 assessment* or measurement*).ti,ab. (4)

8 or/3-7

9 limit 8 to yr="1996 -Current"

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 15
 16 *Database: Cinahl Plus with Full Text (EBSCO host)*

17
 18 Results: n=209

19 Search:

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 21 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
 22 measurement* or evaluat*))

23 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)

24 3 S1 AND S2

25 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
 26 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
 27 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

28
 29 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat*
 30 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND
 31 (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
 32 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")

33 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30

34 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
 35 assessment* or measurement*)

36 8 S3 OR S4 OR S5 OR S6 OR S7

37 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;

38 Exclude MEDLINE records
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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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	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

1	Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
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6	Methods			
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9	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
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14	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
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21	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
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28	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
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33	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
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40	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
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46	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
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52	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
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1	Summary	#13	State the principal summary measures (e.g., risk ratio,	N/A
2	measures		difference in means).	
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4	Planned	#14	Describe the methods of handling data and combining	7
5	methods of		results of studies, if done, including measures of	
6	analysis		consistency (e.g., I ²) for each meta-analysis.	
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8	Risk of bias	#15	Specify any assessment of risk of bias that may affect the	12
9	across studies		cumulative evidence (e.g., publication bias, selective	
10			reporting within studies).	
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12	Additional	#16	Describe methods of additional analyses (e.g., sensitivity or	N/A
13	analyses		subgroup analyses, meta-regression), if done, indicating	
14			which were pre-specified.	
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21	Results			
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23	Study selection	#17	Give numbers of studies screened, assessed for eligibility,	8 + Figure
24			and included in the review, with reasons for exclusions at	
25			each stage, ideally with a flow diagram .	
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28	Study	#18	For each study, present characteristics for which data were	N/A
29	characteristics		extracted (e.g., study size, PICOS, follow-up period) and	
30			provide the citation.	
31				
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33				
34	Risk of bias	#19	Present data on risk of bias of each study and, if available,	12 + Figure
35	within studies		any outcome-level assessment (see Item 12).	
36				
37				
38	Results of	#20	For all outcomes considered (benefits and harms), present,	12-16
39	individual studies		for each study: (a) simple summary data for each	
40			intervention group and (b) effect estimates and confidence	
41			intervals, ideally with a forest plot.	
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44	Synthesis of	#21	Present the main results of the review. If meta-analyses are	11-16
45	results		done, include for each, confidence intervals and measures	
46			of consistency.	
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50	Risk of bias	#22	Present results of any assessment of risk of bias across	N/A
51	across studies		studies (see Item 15).	
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54	Additional	#23	Give results of additional analyses, if done (e.g., sensitivity	N/A
55	analysis		or subgroup analyses, meta-regression [see Item 16]).	
56				

57 Discussion

1	Summary of	#24	Summarize the main findings, including the strength of	16-19
2	Evidence		evidence for each main outcome; consider their relevance	
3			to key groups (e.g., health care providers, users, and policy	
4			makers	
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8	Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of	19
9			bias), and at review level (e.g., incomplete retrieval of	
10			identified research, reporting bias).	
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13	Conclusions	#26	Provide a general interpretation of the results in the context	20
14			of other evidence, and implications for future research.	
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16				
17	Funding			
18				
19	Funding	#27	Describe sources of funding or other support (e.g., supply	21
20			of data) for the systematic review; role of funders for the	
21			systematic review.	
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23				

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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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Secondary Subject Heading:	Surgery, Nursing, Health services research
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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3 1 **Effectiveness of pre-anaesthetic assessment clinic: A systematic review of randomised and**
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5 2 **non-randomised prospective controlled studies**
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10 4 Eirunn Wallevik Kristoffersen^{1,2} *, Anne Opsal¹, Tor Oddbjørn Tveit^{1,2,3}, Rigmor C Berg^{4,5},
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51 21 Word count: 4156
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2
3 24 **ABSTRACT**

4
5 25 **Objectives:** The aim of this systematic review was to examine the effectiveness of pre-
6
7 26 anaesthesia assessment clinics (PACs) in improving the quality and safety of perioperative
8
9 27 patient care.

10
11 28 **Design:** Systematic review.

12
13 29 **Data sources:** The electronic databases CINAHL Plus with Full Text (EBSCOhost), Medline,
14
15 30 and Embase (OvidSP) were systematically searched on 11 September 2018
16
17 31 and updated on 3 February 2020 and 4 February 2021.

18
19 32 **Eligibility criteria:** The inclusion criteria for this study were studies published in English or
20
21 33 Scandinavian language and scientific original research that included randomised or non-
22
23 34 randomised prospective controlled studies. Additionally, studies that reported the outcomes
24
25 35 from a PAC consultation with the patient present were included.

26
27 36 **Data extraction and synthesis:** Titles, abstracts, and full texts were screened by a team of
28
29 37 three authors. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal
30
31 38 checklist for quasi-experimental studies. Data extraction was performed by one author and
32
33 39 checked by four other authors. Results were synthesised narratively owing to the
34
35 40 heterogeneity of the included studies.

36
37 41 **Results:** Seven prospective controlled studies on the effectiveness of PACs, were included.
38
39 42 Three studies reported a significant reduction in the length of hospital stay and two studies
40
41 43 reported a significant reduction in cancellation of surgery for medical reasons when patients
42
43 44 were seen in the PAC. In addition, the included studies presented mixed results regarding
44
45 45 anxiety in patients. Most studies had a high risk of bias.

46
47 46 **Conclusion:** This systematic review demonstrated a reduction in the length of hospital stay
48
49 47 and cancellation of surgery when the patients had been assessed in the PAC. There is a need
50
51 48 for high-quality prospective studies to gain a deeper understanding of the effectiveness of
52
53 49 PACs.

54
55 50 **PROSPERO registration number:** CRD42019137724
56
57 51

58
59 52 **Keywords:** pre-anaesthetic assessment clinic, preoperative care, quality, safety, systematic
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53 review
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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

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2
3 84 6:00 PM.[7] This might indicate that risk factors are both patient- and surgery-related and
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5 85 may be linked to organisational structures.[8]
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9 86 Currently, an increasing number of pre-anaesthesia assessment clinics (PACs) support
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11 87 hospitals internationally in handling the rising number of patients and complexity of surgical
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13 88 procedures.[9] The design of PACs differs critically based on location, organisational
14
15 89 structure, timing, and patient groups. They primarily function as a service unit for surgeons,
16
17 90 patients, and the anaesthetic team.[10] The PAC consultation, by the anaesthesiologist,
18
19 91 anaesthesia nurse, or both, is a globally recognised evaluation method and optimises the
20
21 92 patients' medical condition prior to surgery and anaesthesia.[2] Thus, it is essential for
22
23 93 secure anaesthetic practice since it detects anaesthesia-related risk factors and high-risk
24
25 94 patients, improves patient outcomes, prepares the patient physically and psychologically for
26
27 95 anaesthesia, and ensures the patient's most favourable condition for surgery and
28
29 96 anaesthesia.[11-13] This is primarily performed by interviewing and examining the patient;
30
31 97 reviewing previous medical, surgical and anaesthesia issues; evaluating current medication;
32
33 98 and obtaining and reviewing preoperative tests.[10] PACs also allow increased
34
35 99 communication between healthcare providers and coordination with postoperative
36
37 100 care.[14,15] Because of well-prepared patients and staff, several researchers have indicated
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39 101 that with PAC, the number of surgical cancellations, length of hospital stay, laboratory tests,
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41 102 and mortality rate have reduced.[7,16,17] Others assert that patients feel less anxious
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43 103 regarding the subsequent anaesthetic and surgical processes and are highly satisfied with
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45 104 the service with PAC consultations.[16,18,19]
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56 105 As Turunen *et al.* stated, research on PACs regarding costs, financial savings, the impact on
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58 106 patient safety and quality of care, accuracy of the number of operative patients, and effect
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3 107 on preoperative nursing levels, is scarce.[20] Survey results indicate that anaesthesiologists
4
5 108 perceive day of surgery delays due to missing information as common, even with PAC
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8 109 consultations.[21] This systematic review aimed to examine the effectiveness of PACs in
9
10 110 improving the quality and safety of perioperative patient care. Further, we aimed to
11
12 111 determine the gaps in existing knowledge for future research.
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16 112 **METHODS**

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19 113 Our systematic review followed the guidelines in the Cochrane Handbook for Systematic
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21 114 Reviews of Interventions[22] and was reported in accordance with the Preferred Reporting
22
23 115 Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[23] The protocol was
24
25 116 registered in PROSPERO: CRD42019137724.[24]
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28
29 117 The two review questions were:

- 30
31 118 1. Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?
32
33 119 2. Is PAC effective in reducing cancellation rate and cost of surgery, and improving the
34
35 120 efficiency of perioperative patient care?
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39 121 **Search strategies**

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41
42 122 We performed a scoping search in different databases to identify the key terms.[25,26] The
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44 123 final search was planned and conducted in close collaboration with the university librarian.

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46
47 124 On 11 September 2018 we searched CINAHL Plus with Full Text (EBSCOhost), Medline, and
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49 125 Embase (OvidSP) databases, which were updated on 3 February 2020 and 4 February 2021.

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51
52 126 Considering the lack of subject headings (e.g., MeSH) for PAC, we combined text words, such
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54 127 as 'pre-anaesthesia', 'nurse', 'surgery', 'anaesthesia', 'preoperative', 'assessment',
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56 128 'measurement', 'evaluate', 'preadmission', 'centre', 'clinic', 'ward', 'unit', and 'outpatient'.

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59 129 The searches are detailed in Appendix 1. The search mode in CINAHL was Boolean/Phase,
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3 130 which supports Boolean searching or exact phrase searching. For comprehensiveness, we
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6 131 used both the truncation and proximity operators. We limited the search to 1996, the year
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8 132 one of the first known articles in this area was published.[27] Complementary methods to
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10 133 identify studies included following up on citations via Scopus, scanning the reference lists of
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13 134 relevant papers and included articles, and checking for relevant studies in clinical trials.[25]

15 135 **Eligibility criteria**

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18 136 The main inclusion criterion was that the study, using empirical quantitative methods,
19
20 137 addressed the effectiveness of PACs. Specific eligibility criteria were: (a) published in English
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23 138 or Scandinavian language, (b) scientific publication of original research, (c) reported the
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25 139 outcomes of PAC, (d) PAC consultation with the patient present, (e) randomised or non-
26
27
28 140 randomised prospective controlled studies, and (f) newly established PAC. The following
29
30 141 were excluded: (a) editorials, discussions, and conference abstracts, (b) reviews, (c)
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33 142 instrument testing, (d) studies on children, and (e) retrospective studies.

35 143 **Study selection**

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38 144 All references identified in the search were transferred to EndNoteX9, where the duplicates
39
40 145 were removed. Subsequently, all unique references were transferred to the Covidence
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42 146 screening tool.[28] Study eligibility was ascertained independently, first at the title and
43
44
45 147 abstract level, and subsequently at the full text level. Three of the authors screened all the
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47 148 articles (EWK, AO, MF). Inclusion was determined by consensus, and disagreements were
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49
50 149 resolved by consulting two other authors (RCB and TOT).

52 150 **Quality assessment**

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55 151 Risk of bias in studies were assessed using design-specific checklists. Given the
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57 152 methodological similarity of the studies, only the Joanna Briggs Institute Critical appraisal
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59 153 checklist for quasi-experimental studies was used.[29] Author EWK performed the risk of

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3 154 bias assessment, and RCB confirmed its accuracy. Disagreements were resolved through
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5 155 discussion with MF and AO. Each of the nine checklist questions was answered no, yes,
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7
8 156 unclear, or not applicable.
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10 157 **Data extraction and analysis**

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12
13 158 Author EWK extracted data from each study onto a pre-designed Excel spreadsheet. All the
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15 159 authors confirmed the accuracy, consistency, and completeness of the extracted data that
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17 160 included publication details; study design; setting; and characteristics of the patients,
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19 161 interventions, comparisons, and outcome (PICO). We requested information on the missing
20
21 162 data; however, received no response from the authors. If the PICO elements had been
22
23 163 sufficiently similar and statistical data were available, we had intended to conduct a meta-
24
25 164 analysis. However, the extracted data revealed substantial heterogeneity. Therefore, we
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27 165 performed a narrative synthesis. We described the findings in text, stratified by outcome,
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29 166 with descriptions of the effects of interventions for each study, classification of the effect
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31 167 direction, and we looked across contributing studies to develop a summary of findings for
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33 168 each outcome.[22]
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40 169 **Patient and Public Involvement**

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42 170 Patients and/or the public were not involved in the design, conduct, reporting, or
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44 171 dissemination plans of this research. However, the project was initiated by health
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46 172 professionals.
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51 174 **RESULTS**

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53
54 175 Figure 1. provides the details of the study selection process. A total of 2,981 records were
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56 176 identified in the final search (2021). After removing duplicates, we screened 2,058 records
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3 177 based on the title and abstract; 179 records passed the full-text screening. After applying the
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5 178 inclusion criteria, seven studies were selected for the final analysis.

7
8 179 **Overall characteristics of the studies**

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10 180 The seven studies are listed in Table 1. All seven studies were in English and were published
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12
13 181 between 2000 and 2017, with data collected between 1997 and 2015 (one study did not
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15 182 report data collection information).[30] Based on the inclusion criteria, all were prospective
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18 183 controlled studies; however, no RCTs were found. There was one controlled before-after
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20 184 study.[31] The remaining six studies had control groups; assessments followed PAC
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23 185 implementation, without baseline assessments. There were three two-group non-parallel
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25 186 after-only studies,[32-34] and three two-group parallel after-only studies;[30] one had a
26
27
28 187 matched control group[35] and one had three follow-up assessments of one arm.[36] One
29
30 188 study had only cancellation rate as prospective data.[32] The studies included 77,411
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32
33 189 patients.

190 **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

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

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3 194 Of the 77,411 patients in the studies, 9,626 and 15,531 patients were in the intervention and
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6 195 control groups, respectively. One study did not specify the number of patients in the
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8 196 intervention and control groups, but only the total number of surgeries performed.[36] Five
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10 197 studies reported data for sex, showing that 51% of the patients were women and 49% were
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12 198 men (12,129 vs. 11,583).[30-33,35] There were more women than men in both the
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15 199 intervention (4,345 vs. 4,134) and control groups (7,784 vs. 7,449). Five studies reported
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17 200 data for age showing that all patients were over 20 years of age[30-33,35] and four studies
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19 201 had grouped within the American Society of Anesthesiology (ASA) category.[30,33-35]
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24 203 The patients were scheduled to undergo a variety of surgeries, including
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26 204 orthopaedic,[31,32,34,35] urology,[30-32,35] general,[31,32,35] heart,[33]
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28 205 gynaecology/obstetrics,[31,32,35] vascular surgery,[32] ophthalmology,[32]
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30 206 maxillofacial/dental surgery,[31,32] and neurological surgery,[32] while one did not specify
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32 207 the type.[36] In five studies, the type of anaesthesia was not specified,[31-34,36] and two
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34 208 studies reported patients for general and/or regional supplement.[30,35]
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39 210 The patients included had previous anaesthetic experience in one study,[30] previous and no
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41 211 previous anaesthetic experience in another,[31] and five studies did not report this data.[32-
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43 212 36] Limited background characteristics of the patients were reported in two studies.[34,36]
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45 213 One stated that the patients included had ASA 3 or 4 and a body mass index >40; however,
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47 214 no ASA number, sex, or age was reported.[34] Mendes *et al.* did not report any background
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49 215 characteristics of the included patients.[36]
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3 217 Considering the intervention, the PACs in all studies comprised an outpatient service
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5 218 whereby patients were examined for medical conditions important for anaesthesia and
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8 219 informed regarding expectations on the day of surgery. Nevertheless, the terminology used
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10 220 for PACs varied, as they served different surgical specialities and conducted pre-anaesthesia
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13 221 consultation from ≥ 48 h to ≤ 3 months before the surgery. The settings included a university
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15 222 hospital (n=3),[31,35,36] teaching hospital (n=1),[32] medical centre (n=1),[33] and general
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17 223 hospital (n=1);[34] one study did not specify the context.[30] The staff conducting the pre-
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19
20 224 anaesthetic consultation also varied: in five studies, it was the anaesthesiologists,[30,32,34-
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22
23 225 36] in the other studies, it was (also) the orthopaedic senior house officer,[34] consultant or
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25 226 resident,[31] or physician.[33] In three studies, nurses were part of the team.[32,34,35] The
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27 227 comparison in all studies was usual care, which generally involved a preoperative
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30 228 anaesthetic evaluation of the admitted patients the day before the surgery.

32 229 **Description of risk of bias in the studies**

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35 230 Figure 2. shows the results of the risk of bias assessment. In all seven included studies, the
36
37 231 cause and effect were clear. Most of the studies measured outcomes similarly and used
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39
40 232 appropriate statistical analyses. Several studies had limitations of follow-up and similarity in
41
42 233 care and participants. None of the patients had multiple pre-and post-measurements.

44 234 **Outcomes of the included studies**

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47 235 The outcomes of the included studies are each described separately below.

49 236 *Satisfaction*

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52 237 One study reported satisfaction as an outcome.[35] The summarised patient satisfaction
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54 238 with the anaesthetic consultation score out of 100 showed that the patients in the PAC
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57 239 group were more satisfied (mean difference, 2.10%; 95% confidence interval [CI], 0.51–
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59 240 3.70%; $p=0.01$).[35] There was no statistically significant difference between the two groups
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3 241 in mean patient satisfaction with perioperative anaesthesia care score after surgery (mean
4
5 242 difference 0.01%, $p=0.94$).[35] The quality of recovery (QoR) measure referred to the
6
7 243 patients' quality of recovery score.[37] The mean QoR score (range, 0–18) following
8
9 244 anaesthesia on the first day after surgery was similar between the intervention (13.17 ± 2.73)
10
11 245 and control (13.31 ± 2.65) groups ($p=0.67$).[35]

15 246 *Anxiety*

17 247 Three studies reported anxiety.[30,31,35] Two studies reported the visual analogue scale
18
19 248 (VAS), one rated from zero (no anxiety) to ten (very high anxiety),[30] another used a 100-
20
21 249 mm horizontal line with 'not anxious at all' to 'extremely anxious'.[35] In one study, the
22
23 250 median VAS anxiety score was 3 (0–5) in the intervention group and 5 (2–8) in the control
24
25 251 group ($p=0.0038$).[30] In another study, there were no significant differences between the
26
27 252 control and intervention groups for levels of anxiety (VAS), surgery (26 vs. 25, respectively,
28
29 253 $p=0.12$), and anaesthesia (20 vs. 19, respectively, $p=0.60$).[35] The median Multiple Affect
30
31 254 Adjective Check List (MAACL) score, with possible range of scores from 0 to 21 (higher scores
32
33 255 indicating greater levels of anxiety), was 3 (0–9) in the intervention group and 6.5 (2–12) in
34
35 256 the control group ($p=0.0053$).[30] The differences in the State-Trait Anxiety Index (STAI)
36
37 257 score, which comprised 40 questions rated on a four-point Likert scale, was 1.51 (95% CI:
38
39 258 1.02–2.02%, $p=0.0051$).[31] The results on anxiety in these two studies were significant.
40
41 259 However, Kamau *et al.* found no differences on examining anxiety and the influences of sex,
42
43 260 duration of hospital stay, and prior anaesthesia experience.[31]

51 261 *Mortality*

52 262 One study reported the mortality rates.[34] Patients attending the High Dependency Unit
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54 263 (HDU), Intensive Care Unit (ICU), and Post-anaesthesia Care Unit (PACU) following complex
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3 264 orthopaedic surgery had a significant reduction in mortality rate after being assessed at the
4
5 265 PAC, from 18 (6.1%) of 298 patients to 14 (1.2%) of 1147 patients ($p=0.001$).[34]
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8 266 *Cancellation rate*

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10 267 Four studies reported reduced cancellation rates following the establishment of a
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12 268 PAC.[32,33,35,36] One of the included studies had 316 (2.0%) cancellations for medical
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14 269 reasons before the introduction of PAC, and 79 (0.9%) after, with a difference of 1.02% (95%
15
16 270 CI, 0.31–1.31%). After adjustment, the odds ratio was 0.7 (95% CI, 0.5–0.9%).[32] The overall
17
18 271 cancellation of surgery reduced from 1027 (6.3%) to 393 (4.6%) following PAC introduction,
19
20 272 with a difference of 0.9% (95% CI, 0.3–1.0%).[32] Mendes *et al.*[36] found a decrease in
21
22 273 overall cancellations from year 1 (39.3%) to year 4 (15.9%), $p \leq 0.05$. In the first year of their
23
24 274 study, there were 469 cancellations per 10,639 surgeries performed. The following year, a
25
26 275 considerable increase above the baseline in the intervention group was observed, followed
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28 276 by a progressive decrease in the last year with 391 cancellations per 10,397 surgeries
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30 277 performed.[36] Farasatkish *et al.* reported that of the 1,716 patients studied, a mean of 15.1
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32 278 % cancelled in the two groups. The cancellation rates in the control and intervention groups
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34 279 were 16.8% (146 [number of cancellations]/866 [number of surgeries]) and 13.29%
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36 280 (113/850) ($p=0.046$), respectively. The most common reason for cancellation was
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38 281 incomplete medical work-up; 51/146 (35%) in the control group and 32/113 (28%) in the
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40 282 intervention group ($p=0.03$).[33] Lee *et al.* found similar rates for surgery being cancelled on
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42 283 the scheduled date for the intervention group compared with the control group (2.3% vs.
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44 284 3.4%, $p=0.75$).[35]
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57 286 *Costs and willingness to pay*

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3 287 Two studies reported the costs.[34,35] One study reported a total saving of £ 486.62 per
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6 288 patient after establishing a PAC.[34] Another reported a significantly lower preoperative cost
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8 289 per patient in the intervention group compared with that of the control group (mean
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10 290 difference, \$ 463; 95% CI, -\$648 to -\$278 per patient, $p < 0.01$).[35] However, the mean
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13 291 difference in the total perioperative treatment cost was not significant, even after adjusting
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15 292 for cancellation on the day of surgery costs.[35] Compared to the control group, the
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18 293 willingness to pay (WTP) among the intervention group patients was significantly more than
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20 294 the median WTP (US \$13) for a clinic consultation at the PAC.[35]

22 295 *Length of stay*

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25 296 The length of stay was reported in three studies.[34-36] Mendes *et al.*[36] found a significant
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27 297 decrease in mean hospital stay of patients from 6.2 to 5.0 days ($p \leq 0.001$) during the 4 years
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29
30 298 of this study. Kamal *et al.*[34] found a significant reduction in the length of stay in the HDU
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32 299 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
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35 300 last study, no significant changes were found in the median duration of postoperative stay
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37 301 between the intervention and control groups.[35]

39 302 *Organisation planning and efficiency*

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42 303 Organisation planning and efficiency have been reported in two studies.[34,36] One study
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44 304 found statistically significant changes in the reduction of unplanned admissions to the PACU
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46 305 (65/298 [22%], 111/1147 [10%], $p = 0.001$), ICU (4/298 [1.3%], 4/1147 [0.4%], $p = 0.01$), and
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49 306 HDU (4/298 [1.34%], 20/1147 [1.7%], $p = 0.01$) after implementing a PAC.[34] The planned
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52 307 admissions in the ICU (4/298 [1.3%], 18/1147 [1.6%], $p = 0.01$), and HDU (14/298 [4.7%],
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54 308 85/1147 [7.4%], $p = 0.1$) increased after implementing a PAC.[34] The number of PAC
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57 309 evaluations increased from 14,704 (year 1) to 413,990 (year 4) ($p \leq 0.001$).[36] The number
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3 310 of outpatient procedures increased from 2,170 (year 1) to 1,943 (year 4) ($p \leq 0.001$) and the
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5 311 inpatient procedures decreased from 9,556 (year 1) to 8,449 (year 4) ($p \leq 0.001$).[36]
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8 312
9 313 **DISCUSSION**

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11 314 This systematic review summarises the effectiveness of PACs in improving quality and safety
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13 315 of pre-anaesthetic patient care in general hospitals and determines the gaps in existing
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15 316 knowledge for future research. Herein, we present the main results of the review and infer
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17 317 the implications for research and practice.
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23 319 Seven studies met the inclusion criteria, and the main findings were reduction in the length
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25 320 of stay and surgery cancellation rate in hospitals. However, the studies were of low quality,
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27 321 making it difficult to draw any conclusion. The evidence from our systematic review is
28
29 322 insufficient to conclude whether patients have reduced anxiety because of PAC. This is
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31 323 because the included studies used different instruments for measuring anxiety levels, and
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33 324 the results could not be pooled.[38]
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41 326 A major purpose of establishing a PAC in a hospital is to better prepare the patients for the
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43 327 anticipated surgery. Healthcare professionals and policymakers are exploring strategies to
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45 328 reduce unnecessary investigations without compromising quality of care and patient
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47 329 safety.[39] Transition of evidence-based interventions to the hospital systems can provide
48
49 330 substantial benefits to patient care.[40] According to the ASA and the National Institute of
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51 331 Health and Care Excellence, routine preoperative laboratory tests are not recommended for
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53 332 relatively healthy patients. Instead, they encourage patient and surgery- specific
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55 333 investigations.[15,40] This recommendation is not always implemented in hospital protocols
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3 334 or practice. An observational study showed that routine preoperative testing to predict
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5 335 abnormalities found at least one abnormal test result in most of the relatively healthy
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8 336 patients. Only 0.67% of the abnormalities had a significant impact on changing the
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10 337 perioperative management.[41] Blitz *et al.* argued that PACs should focus on early patient
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12 338 engagement strategies, interdisciplinary team communication, detailed perioperative care
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14 339 plans, and patient documentation using electronic health record, which should be open for
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16 340 review by the perioperative team.[14] Furthermore, a previous study mentioned that the
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18 341 risk factors are not only patient-related but also organisation-related,[7] and that some
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20 342 hospitals have perioperative care teams that are better at identifying and relieving
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22 343 perioperative complications.[42,43] Thus, the value of PACs lies in their ability to improve
23
24 344 the quality of the perioperative process by designing a more robust system for preoperative
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26 345 assessment and preparation.[14] A narrative review found higher rates of morbidity and
27
28 346 mortality in non-operating room anaesthesia, and one of the main reasons was limited
29
30 347 preoperative evaluation.[6] In this systematic review, the assessment of PAC was
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32 348 significantly associated with reduced mortality following complex orthopaedic surgery in
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34 349 only one study.[34] Retrospective studies have reported similar results, but with different
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36 350 surgeries.[14,44]

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46 352 Cancellation on the day of surgery has undesirable effects on both the patients and the
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48 353 hospital system.[13] Late patient-related cancellations can totally or partially be
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50 354 prevented,[45] if addressed during preoperative evaluations.[16] This has been confirmed by
51
52 355 only three studies in this systematic review that found a reduction in surgery cancellation
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54 356 after implementing a PAC.[32,33,36] However, Lee *et al.* found no significant changes
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56 357 between the intervention and control groups.[35] Mendes *et al.* found that the number of
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3 358 cancellations for medical reasons after PAC implementation decreased in the first year of
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6 359 implementation. In the second and third years, they were high before the number dropped
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8 360 to below baseline.[36] These conflicting findings indicate that hospitals operate in specific
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10 361 contexts, with unique populations, processes, and microsystems, encountering unique
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13 362 obstacles, making implementation difficult. Patient-focused interventions should consider
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15 363 barriers, facilitators, and interrelationships between systems, staff, and interventions to
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18 364 increase the likelihood of sustainable success.[46] Additionally, Kamal *et al.* indicated that
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20 365 PACs lead to more planned admissions to the ICU, HDU, and PACU, which is more
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23 366 predictable for patients, staff, and administration.[34]
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27 368 Another finding of this review was a significant reduction in the length of hospital stay
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30 369 following patients' examination in a PAC; however, a small number of studies with low
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33 370 quality were considered. Nevertheless, similar results were found in another systematic
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35 371 review claiming that perioperative systems support the hospitals by addressing the expected
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37 372 growth in the number and complexity of surgical procedures.[16] When patients are
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40 373 examined in the PAC and well-prepared with information, consultations, and tests, they
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42 374 need not be hospitalised until the day of surgery. A survey on operated patients showed that
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45 375 given a choice, 75% do not wish admission to the hospital until the day of operation; a major
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47 376 reason being shorter hospital stay.[47] An updated systematic review on the effectiveness of
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50 377 nurse-led preoperative assessment services for elective surgery found that the included
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52 378 articles demonstrated a reduced length of stay; these studies had low methodological
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55 379 quality, and therefore, the authors could not conclude that this service leads to reduced
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57 380 length of hospital stay.[17]
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382 **Strengths and limitations of the study**

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

394
395 We exclusively included studies with high internal validity. Therefore, several retrospective
396 studies were excluded. Nonetheless, as the remaining studies' risk of bias was fairly high,
397 and they were heterogeneous, a meta-analysis was not statistically appropriate.[26] The
398 included studies' designs could not rule out selection bias and confounders; thus, the
399 strength of the evidence should be assessed cautiously. Many studies did not adjust for
400 several confounders, which could be responsible for the observed effects. Several studies
401 lacked descriptions of the methods used and the patients included, lowering transparency.
402 The results are relevant to health care services, focusing on the well-being and safety of the
403 patients.

405 **Implications for future research and practice**

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3 406 This systematic review identified the ambiguity in the PAC interventions offered to the
4
5 407 intervention group. In many studies, it was evident that the methods used lacked clarity, and
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7 408 high-quality research is needed in this field. The included studies did not demonstrate earlier
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9 409 surgical room entry time[49,50] or reduction in the number of preoperative tests for
10
11 410 patients attending the PAC, similar to the results of the retrospective studies.[27]
12
13 411 Other implications may include the organisation structure of different PACs and their
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15 412 functioning. Additionally, the tests that should be part of the assessment at the PACs should
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17 413 be investigated. The use of technology, such as streaming services, facilitates different
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19 414 patient groups and might become crucial for reducing human contact and spread of
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21 415 infection in context of coronavirus disease 2019.
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28 416 **CONCLUSION**

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30 417 PAC use has reduced the length of stay and surgery cancellation rate at hospitals. However,
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32 418 the effectiveness of PAC, the major review question, remains unclear, and requires further
33
34 419 research. There is a demand for high-quality studies capturing robust data describing the
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36 420 quality of care and clinical outcomes for patients requiring anaesthesia. This requires
37
38 421 increased focus and funding for this specific area of health services research and could,
39
40 422 therefore, lead to implementation of PACs in health care services and improve patient safety
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42 423 and perioperative care.
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48
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50
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52
53

54 427 **Competing Interests**

55
56 428 The authors declare that they have no conflict of interest.
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59 429 **Data sharing statement**

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3 430 All data relevant to the study are included within the article or have been uploaded within
4
5 431 supplemental files.

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13
14
15 435 **Author contributions**

16
17 436 EWK, MF, AO, and TOT: Study design

18
19 437 EWK, MF, AO: Search and screening of the articles

20
21 438 EWK: Data extraction

22
23 439 MF, AO, RCB, and TOT: Control of data extraction

24
25 440 EWK, MF, AO, and RCB: Quality assessment of the included articles

26
27 441 EWK: Drafting of the manuscript

28
29 442 MF, AO, RCB, and TOT: Contribution to and review of the final version of the manuscript

30
31 443 MF, AO, RCB, and TOT: Supervised the study

32
33 444 **References**

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596 **Figure legends**

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

599 [23]

600 Figure 2: The Joanna Briggs Institute Critical appraisal checklist for quasi-experimental

601 studies was used for the risk of bias assessment. [29]

For peer review only



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Identification

Records identified through
database searching
(n=2981)

(Embase n=1572, Cinahl n=209,
Medline n=1200)

Screening

Duplicates removed
(n=923)

Title and abstract screened
(n=2058)

Records excluded
(n=1879)

Eligibility

Full-text articles assessed
for eligibility
(n=179)

Full-text articles excluded,
with reasons
(n=173)

- 82 wrong study design
- 27 not a preoperative anaesthesia clinic
- 23 not a research paper
- 18 abstract/conference/ editorial letter
- 15 wrong interventions/ setting
- 2 full text not available
- 4 duplicates
- 2 wrong languages

Studies included in
systematic review
(n=6)

Included

Additional searching in
references (=1)

Studies included in
systematic review
(n=7)

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

	Are cause and effect clear?	Are comparison participants similar?	Did comparison participants have similar care?	Was there a control group?	Were there multiple pre post measurements?	Was follow-up complete?	Were outcomes measured the same way?	Were outcomes measured in reliable way?	Was appropriate stat analysis used?
Farasatkish 2009	+	+	?	+	-	?	+	+	+
Kamal 2011	+	?	?	+	-	?	?	?	?
Kamau 2017	+	+	-	+	-	+	+	+	+
Klopfenstein 2000	+	-	+	+	-	?	+	+	+
Lee 2012	+	+	-	+	-	?	+	+	+
Mendes 2005	+	?	?	+	-	?	?	?	+
van Klei 2002	+	+	-	+	-	?	+	+	+

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

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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

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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*)).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*)).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*)).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 remove duplicates from 9

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21 *Database: Cinahl Plus with Full Text (EBSCOhost)*

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23 Results: n=132

24 Search:

25 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
26 measurement* or evaluat*))
27 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
28 3 S1 AND S2
29 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
30 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
31 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
32 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
33 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
34 or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
35 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
36 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic*
37 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
38 assessment* or measurement*)
39 8 S3 OR S4 OR S5 OR S6 OR S7
40 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-
41 20181231; Exclude MEDLINE records
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46 3. Search update, 3 February 2020

47 3.1. Main Databases

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49
50
51 *Database: Embase (Ovid)*

52
53 Results: n=1453

54 Search:

55 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
56 measurement* or evaluat*)).ti.
57 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
58 3 1 and 2
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3 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
4 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
5 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*).ti,ab.
6 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
7 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
8 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
9 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
10 anesthe*).ti,ab.
11 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
12 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
13 assessment* or measurement*).ti,ab.
14 8 or/3-7
15 9 limit 8 to yr="1996 -Current"
16 10 limit 9 to (conference abstracts or embase)

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22 *Database: Medline (Ovid)*

23
24 Results: n=1105

25 Search:

26 1 ((pre-operativ* or preoperativ* or pre operativ*) and (assessment* or
27 measurement* or evaluat*).ti.
28 2 (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*).ti.
29 3 1 and 2
30 4 ((preanaesthe* or pre-anaesthe* or pre anaesthe* or pre-anesthe* or
31 preanesthe* or pre anesthe*) adj4 (assessment* or measurement* or evaluat* or
32 clinic* or nurs* or unit* or outpatient* or ward* or center* or centre*).ti,ab.
33 5 (((pre-admiss* or preadmiss*) adj4 (assessment* or measurement* or evaluat*
34 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
35 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
36 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
37 anesthe*).ti,ab.
38 6 ((anaesthe* or anasthe* or anesthe*) adj4 outpatient* adj4 clinic*).ti,ab.
39 7 ((pre-admiss* or preadmiss*) adj4 (center* or centre*) adj4 (evaluat* or
40 assessment* or measurement*).ti,ab.
41 8 or/3-7
42 9 limit 8 to yr="1996 -Current"

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47 *Database: Cinahl Plus with Full Text (EBSCO host)*

48 Results: n=166

49 Search:

50 1TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
51 measurement* or evaluat*))
52 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)
53 3 S1 AND S2
54 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
55 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
56 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)
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5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat* or
 6 clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND (surg*
 7 or anaesthe* or aneste* or preoperativ* or "pre operativ*" pre-operativ* or
 8 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")
 9 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 23
 10 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evalu* or assessment*
 11 or measurement*)
 12 7 S3 OR S4 OR S5 OR S6 OR S7 487
 13 8 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;
 14 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 aneste* 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 (evalu* 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*
 6 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) and (surg*
 7 or anaesthe* or anesthe* or preoperativ* or pre-operativ* or preanaesthe* or pre-
 8 anaesthe* or pre anaesthe* or pre-anesthe* or preanesthe* or pre
 9 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
 8 assessment* or measurement*).ti,ab. (4)

8 or/3-7

9 limit 8 to yr="1996 -Current"

16 *Database: Cinahl Plus with Full Text (EBSCO host)*

18 Results: n=209

19 Search:

20 1 TI ((pre-operativ* or preoperativ* or "pre operativ*") AND (assessment* or
 21 measurement* or evaluat*))

22 2 TI (clinic* or unit* or nurs* or outpatient* or ward* or center* or centre*)

23 3 S1 AND S2

24 4 (preanaesthe* or pre-anaesthe* or "pre anaesthe*" or pre-anesthe* or
 25 preanesthe* or "pre anesthe*") N3 (assessment* or measurement* or evaluat* or
 26 clinic* or nurs* or unit* or outpatient* or ward* or centre* or center*)

27 5 ((pre-admiss* or preadmiss*) N3 (assessment* or measurement* or evaluat*
 28 or clinic* or unit* or nurs* or outpatient* or ward* or centre* or center*)) AND
 29 (surg* or anaesthe* or anesthe* or preoperativ* or "pre operativ*" pre-operativ* or
 30 preanaesthe* or pre-anaesthe* or pre-anesthe* or preanesthe* or "pre anesthe*")

31 6 (anaesthe* or anasthe* or anesthe*) N3 outpatient* N3 clinic* 30

32 7 (pre-admiss* or preadmiss*) N3 (center* or centre*) N3 (evaluat* or
 33 assessment* or measurement*)

34 8 S3 OR S4 OR S5 OR S6 OR S7

35 9 S3 OR S4 OR S5 OR S6 OR S7 Limiters - Published Date: 19960101-;

36 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



PRISMA 2020 Checklist

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

For peer review only

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