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Virtual preoperative assessment in surgical patients: A systematic review and meta-analysis

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ABSTRACT

Study objective: Preoperative assessment is a standard evaluation, traditionally done in-person in a preanesthesia clinic, for patients who will be undergoing a procedure involving anesthesia. Given the increased adoption of virtual care during the coronavirus disease 2019 (COVID-19) pandemic, the purpose of this systematic review and meta-analysis is to review the effectiveness of virtual preoperative assessment for the evaluation of surgical patients.

Design: Systematic review and meta-analysis.

Setting: MEDLINE (Ovid), MEDLINE InProcess/ePubs, Embase, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and ClinicalTrials.gov were searched from the initial coverage of the respective database to May 2021. A manual citation search of Google Scholar and PubMed was conducted to identify missed articles. Continued literature surveillance was done through July 2021.

Patients: Patients aged 18 years and older undergoing virtual preoperative anesthesia assessment.

Intervention: Virtual preoperative assessment.

Measurements: Surgery cancellation rates, patient experience, resources saved, staff experience, success in using the data collected to diagnose and manage patients.

Main results: Fifteen studies (n = 31,496 patients) were included in this review. The average age of patients was 58 ± 15 years, and 47% were male. Virtual preoperative assessment resulted in similar surgery cancellation rates compared to in-person evaluation, with a pooled cancellation rate of 2% (95% confidence interval [CI]: 1–3%). Most studies reported a positive patient experience, with a pooled estimate of 90% (95% CI, 81–95%). There was a high success rate in using the information collected with virtual care, in the range of 92–100%, to diagnose and manage patients resulting in time and cost savings in the range of 24–137 min and $60–67 per patient.

Conclusions: This systematic review and meta-analysis demonstrates the utility of virtual care for preoperative assessment of surgical patients. Virtual preanesthesia evaluation had similar surgery cancellation rates, high patient satisfaction, and reduced costs compared to in-person evaluation.

1. Introduction

Preoperative assessment is a standard evaluation for patients who will be undergoing a procedure involving anesthesia [1]. The assessment is traditionally done in-person in a preanesthesia clinic before or on the day of the procedure, with the goal of tailoring an optimal anesthetic plan to reduce perioperative risk and increase patient satisfaction [1,2]. Information is collected regarding the patient's medical history, such as current and past medical illnesses, comorbidities, medications, allergies, previous surgical history, experiences with anesthesia, substance abuse, chance of pregnancy, and susceptibility to malignant hyperthermia [1,2]. A physical examination to assess body mass index, vital signs, airway, cardiovascular, and respiratory function is also conducted [1,2]. Patients are subsequently classified according to the American Society of...
Anesthesiologists (ASA) physical status classification system [3]. Pre-operational assessment has led to many benefits, including decreased surgical delays, cancellations, and costs, and an increase in patient and staff satisfaction [4–8].

With the recent emergence of the coronavirus disease 2019 (COVID-19) pandemic, medical teams have been faced with the challenge of maintaining adequate and timely care for their patients while minimizing the risk of transmission of COVID-19 [9,10]. A solution, which has become increasingly adopted by anesthesia teams, is the utilization of contactless tools, commonly referred to as virtual care, telemedicine, or telehealth to communicate and care for patients [9,10]. This generally involves an anesthesia team member contacting a patient remotely through telephone or a videoconferencing platform [11,12]. In more advanced settings, an anesthesia team member may perform complex physical examinations on the patient, including applications to gather vital signs and cameras to assess the airway [11].

Given the increased adoption of virtual care during the COVID-19 pandemic, the purpose of this systematic review and meta-analysis is to review the effectiveness of virtual preoperative assessment for the evaluation of surgical patients, with a focus on surgery cancellation rates and patient experience.

2. Methods

2.1. Study design and registration

The protocol of this study was registered in the International Prospective Register of Systematic Reviews (PROSPERO; CRD42021262087). We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline [13,14]. The PRISMA checklist is provided in Appendix: Table A1.

2.2. Search strategy

We searched for articles published in the following electronic databases: MEDLINE (Ovid), MEDLINE InProcess/ePubs, Embase, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and ClinicalTrials.gov. The search strategy was designed and executed by an information specialist experienced in literature search (ME). All queries started from the initial coverage of the respective database to May 2021. Results were limited to humans, adults, and articles with English abstracts. In addition, we conducted citation searching using Google Scholar and the reference list of included articles. Continued literature surveillance was done through July 2021. The detailed search strategy is provided in Appendix: Table A2. All citations were imported into EndNote X8 to remove duplicates.

2.3. Study selection and data extraction

Three reviewers (KZ, MR, RW) independently conducted title and abstract screening using Rayyan [15]. KZ and MR independently conducted full-text evaluation, data extraction, and risk of bias assessment. Full-text articles were selected according to the following inclusion criteria: the study assessed virtual preoperative assessment in adult patients aged 18 years and older. Reviews, case reports, conference proceedings, dissertations, and book chapters were excluded. One article was translated into the English language [16]. Patient characteristics and outcome data were extracted using standardized forms in an Excel sheet. Any disagreements between the reviewers were resolved by the senior author (FC). Corresponding authors were contacted by email for missing information.

Characteristics extracted included year of publication, country, study design, type of surgery, sample size, age, gender, ASA classification (I–IV), and devices used for assessment. Surgery cancellation rates and patient experience data were extracted and converted into proportions where appropriate. For studies which provided the frequency of patient responses to questions pertaining to patient experience on Likert scales, the corresponding data was extracted for meta-analysis. The primary outcomes were surgery cancellation rates and patient experience. The secondary outcomes included resources saved, staff experience, and success in using the data collected to diagnose and manage patients.

2.4. Quality assessment

The quality of the included studies was assessed by the reviewers (KZ, MR) independently using the Newcastle-Ottawa Scale (NOS) and the Joanna Briggs Institute’s (JBI) critical appraisal tools [17–19]. The NOS quality assessment forms were used to appraise cohort and cross-sectional studies [17,18]. The NOS checklist includes questions related to selection, comparability, and outcomes. Questions about selection and outcomes were evaluated using 1 star (*) for most categories, while questions regarding comparability could be allocated a maximum of 2 stars (**). None of the studies explicitly controlled for factors such as age, gender, and ASA classification, however, stars for comparability were awarded if the data was provided for the intervention and control group in the studies. JBI critical appraisal checklists were used for case series and randomized controlled trials [19]. This checklist includes questions about appropriateness of study design, study population, outcomes, and statistical analysis. Questions were evaluated using four options: yes, no, unclear, or not applicable. The reviewers met to discuss the results of their appraisal and any outstanding disagreements were resolved by the third author (RW).

2.5. Statistical analysis

Pooled estimates for surgery cancellation rates and positive patient experience were calculated using random effects meta-analysis in accordance with the DerSimonian and Laird method [20]. Heterogeneity was evaluated using the I² statistic with values of <30%, 30–60%, and >60% denoting low, moderate, and high levels of heterogeneity, respectively [21].

Meta-regression was conducted to assess the effect of covariates such as age, gender, and ASA classification (I–IV) on the estimates. Sensitivity analysis or influential analysis was conducted to examine the source of heterogeneity with one study removed each time. Reporting bias was assessed using an Egger’s test [22]. A p-value of <0.05 was considered statistically significant. All analyses were conducted using RStudio 1.4.1717.

3. Results

The literature search resulted in 10,058 articles (Fig. 1). After screening titles and abstracts, 8424 studies were excluded because they did not meet the predetermined inclusion criteria. Of the remaining 30 studies, 15 full-text articles were excluded [23–37]; the reasons for exclusion are listed in Appendix: Table A3. Fifteen studies met the inclusion criteria for qualitative synthesis, of which 12 studies were included for the meta-analysis of surgery cancellations and patient experience [12,16,38–50]. The included studies encompassed 31,496 patients and were conducted in six different countries: Australia [42,50], Canada [38], Hong Kong [48], Ireland [46], Spain [16], and the United States [12,39–41,43–45,47,49]. The studies were published between 1999 and 2020.

3.1. Study characteristics

The demographics of the included studies are summarized in Table 1. The average age of patients was 58 ± 15 years, and 47% were male. The proportion of patients with an ASA classification of I, II, III, and IV was 5%, 39%, 52%, and 4%, respectively. Three studies investigated outpatient surgery [39,41,47], one studied inpatient surgery [43], while the others investigated a mix of both inpatient and outpatient surgery or...
Fig. 1. PRISMA flow diagram.

Table 1
Characteristics of included studies.

| Study (year)       | Country    | Study design | Type of surgery                        | Sample size (N) | Age (mean ± SD years) | Gender (% Male) | ASA class I, II, III, IV (%) |
|--------------------|------------|--------------|----------------------------------------|-----------------|------------------------|-----------------|-----------------------------|
| **Studies with a comparison group** |
| Wong (2004) [38]   | Canada     | Case series  | Non-cardiac                            | 10              | 58 ± 14                | 20              | 0, 40, 60, 0                |
| Blanco Vargas (2012) [16] | Spain      | Case series  | All                                    | 11,979          |                        | NR              | NR                          |
| Applegate (2013) [12] | US         | RCT          | Head and neck                          | 155             | 55 ± 15                | 58              | 5, 46, 47, 3                |
| Lozada (2016) [39]  | US         | PC           | All                                    | 75              | 55 ± 14                | 35              | 4, 52, 40, 4                |
| Wood (2016) [10]    | US         | RC           | Oral and maxillofacial                 | 335             | 33 ± 9                 | 99              | NR                          |
| Goodhart (2017) [41] | US         | PC           | All                                    | 300             | 54 ± 15                | 35              | 29, 56, 16, 0               |
| Tam (2017) [42]     | Australia  | RC           | All                                    | 229             | 65 ± 12                | 63              | 1, 43, 50, 6                |
| Afable (2018) [43]  | US         | RC           | All                                    | 7988            | Veterans               | NR              | NR                          |
| Mullen-Fortino (2019) | US        | RC           | All                                    | 7903            | 58                     | 47              | NR                          |
| **Studies without a comparison group** |
| Rollert (1999) [47] | US         | RC           | Dentalveolar                            | 43              | 30                     | 91              | NR                          |
| Law (2009) [48]     | Hong Kong  | RCT          | Breast                                 | 283             | 18-45                  | NR              | NR                          |
| Zetterman (2011) [49] | US         | PC           | Urology                                | 41              | NR                     | NR              | NR                          |
| Roberts (2015) [50] | Australia  | Cross-sectional | All                                     | 29              | NR                     | NR              | NR                          |

Abbreviations: ASA, American Society of Anesthesiologists; NR, not reported; PC, prospective cohort; RC, retrospective cohort; RCT, randomized controlled trial; SD, standard deviation; US, United States.

* Information was provided by corresponding author (O’Shea, personal communication, July 7, 2021).
did not specify. Seven studies were retrospective cohort studies [16,40,42,44,47,48], five were prospective cohort [39,41,45,46,49], and there was one case series [38], one randomized controlled trial [12], and one cross-sectional study [50]. All of the studies compared virtual care to in-person preoperative assessment, with the exception of four studies without a comparison group [47–50]. The average time between preoperative assessment and surgery was in the range of 1–34 days [39,47,48]. The average duration of virtual preoperative assessment was 27 (range: 25–60) minutes [38,42,44,45].

Of the 15 included studies, nine (60%) used videoconferencing [12,38,40,42,44,45,47,49,50], three (20%) used telephones [16,39,48], two (13%) employed electronic questionnaires [41,46], and one (7%) used electronic consultations through a shared electronic health record or web-based portal [43]. Patients were assessed by anesthesiologists in eight studies [16,38,41–43,45,46,50], by residents in eight studies [12,39–41,45–47,49], by nurses in six studies [16,39,41,45,46,48], and by nurse practitioners in four studies [12,42–44]. In three studies, the initial assessments were reviewed by anesthesiologists [39,48,49]. Five studies (33%) conducted physical examinations using electronic stethoscopes [12,38,40,47,50].

Six studies used Likert scales to measure patient experience [38,41,44,45,49,50] and one used dichotomous scales [39]. Of these studies, only Goodhart and colleagues [41] reported using a validated Likert questionnaire [51].

### 3.2. Surgery cancellations

The outcomes of the included studies are summarized in Table 2. Among the 11 studies with a comparison group, four (36%) reported no difference in surgery cancellations with virtual care compared to in-person preoperative assessment [12,39,43,44], two (18%) reported similar cancellation rates [16,45], while one (9%) estimated lower cancellation rates with virtual preoperative assessment [42], and four (36%) did not report this outcome [38,40,41,46]. All four studies (100%) without a comparison group reported no cancellations with virtual preoperative assessment [47–50]. Reasons for surgery cancellations included patient refusal, limited surgeon or equipment availability, insurance issues, unavoidable medical reasons, and inappropriate

### Table 2

Summary of outcomes.

| Study (year) | Sample size (N) | Device Description | Surgery cancellations | Patient experience | Other outcomes |
|--------------|----------------|--------------------|-----------------------|--------------------|----------------|
| **Studies with a comparison group**
| Wong (2004) [38] | 10 | Videoconferencing, Tandberg 880, monitor, camera, computer, examination camera, electronic stethoscope | NR | Virtual care: 100% satisfied or highly satisfied | Virtual care: 0% missing information, 100% of anesthesiologists satisfied or highly satisfied |
| Blanco Vargas (2012) [16] | 11,979 | Telephone, electronic questionnaire (28% in virtual care group received in-person visit) | Virtual care: 1.7%; usual care: 2.3% | NR | NR |
| Applegate (2013) [12] | 155 | Videoconferencing, high-definition camera and audio on a wireless cart, examination camera, electronic stethoscope | No difference | No difference | Airway management difficulty predicted equally, >98% agreement for heart and lung examinations, no difference in staff satisfaction |
| Lozada (2016) [39] | 75 | Telephone | No difference | Virtual care: 97% satisfied | NR |
| Wood (2016) [40] | 335 | Videoconferencing, intraoral camera, electronic stethoscope | NR | NR | Virtual care: 92.2% success in using data to diagnose and treat, 96.9% of patients triaged correctly, and mean cost saved: $60 per patient |
| Goodhart (2017) [41] | 300 | Electronic questionnaire | NR | Virtual care: 83% enjoyed completing questionnaire, 98% happy to complete in future | 66.5% agreement for ASA classification, 93–100% agreement for comorbidities and medications |
| Tam (2017) [43] | 229 | Videoconferencing | Virtual care: 3.1%; usual care: 10% | NR | NR |
| Ablable (2018) [44] | 7988 | Electronic consultations using a shared electronic health record or web-based portal | No difference | Virtual care: 4.8/5.0 satisfied | Virtual care: mean time saved: 24 min per patient |
| Mullen-Fortino (2019) [44] | 7803 | Videoconferencing, JeffConnect application | No difference; virtual care: 0%; usual care: 1.1% | Virtual care: 98% agree or strongly agree that they were satisfied | Virtual care: median distance saved: 63 miles, median time saved: 130–137 min, median cost saved: $67 per patient |
| Kamdar (2020) [45] | 2204 | Videoconferencing | Virtual care: 2.9%; usual care: 3.2% | Virtual care: 92% acceptability | 77.3% correct ASA classification |
| O’Shea (2020) [46] | 22 | Web application that delivers 22 question survey with algorithm to stratify patient risk | NR | Virtual care: 92% satisfaction | |
| **Studies without a comparison group**
| Rollert (1999) [47] | 43 | Videoconferencing, V-TEL Media Max, examination and document-stand cameras, fax machine, electronic stethoscope | Virtual care: 0% | NR | Virtual care: 100% of patients assessed correctly, 94% of patients able to undergo surgery at the immediate appointment after virtual care consultation |
| Law (2009) [48] | 283 | Telephone | Virtual care: 0% | NR | Virtual care: 87.5% of patients stated that they could save time and money, 97.6% of patients stated that virtual care could reduce stress by preventing travel |
| Zetterman (2011) [49] | 41 | Videoconferencing | Virtual care: 0% | Virtual care: 71% preferred | VR |
| Roberts (2015) [50] | 29 | Videoconferencing, electronic stethoscope | Virtual care: 0% | Virtual care: 81% preferred | VR |

**Abbreviations:** ASA, American Society of Anesthesiologists; NR, not reported.
patient fasting [12,42]. In a random effects model with eight studies [16,42,44,45,47–50], the pooled cancellation rate with virtual care was 2% (95% confidence interval [CI]: 1–3%). There was a moderate level of non-significant heterogeneity identified across the studies ($I^2 = 45\%$, $p = 0.08$). A forest plot of surgery cancellation rates with virtual preoperative assessment is presented in Fig. 2. Meta-regression showed that there was no significant effect of covariates.

Leave-one-out sensitivity analysis showed that there was no effect of removing any study on the overall pooled prevalence of surgery cancellations. Egger’s test showed that there was no publication bias ($t(6) = -0.55$, $p = 0.602$). Due to the low number of studies, the results for Egger’s test should be interpreted with caution.

3.3. Patient experience

Among the 11 studies with a comparison group, six (55%) reported a positive patient experience with virtual preoperative assessment [38,39,41,44–46], while one (9%) reported no difference [12], and four (36%) did not report this outcome [16,40,42,43] (Table 2). Two (50%) of the four studies without a comparison group reported a preference for virtual care [49,50]. A forest plot of positive patient experience with virtual preoperative assessment is presented in Fig. 3. In a random effects model with seven studies [38,39,41,44–46], the pooled proportion of patients with a positive patient experience with virtual care was 90% (95% CI: 81–95%). There was a high level of heterogeneity across the studies ($I^2 = 79\%$, $p < 0.01$). The meta-regression analysis showed a significant relationship between ASA III classification of patients and positive patient experience ($\beta = 0.06$, 95% CI: 0.01–0.10, $p < 0.01$) (Appendix: Fig. A1). No significant interaction was observed for other covariates.

Leave-one-out sensitivity analysis showed that there was no effect of removing any study on the overall pooled prevalence of positive patient experience. Egger’s test showed no evidence of publication bias ($t(5) = 1.72$, $p = 0.146$). Due to the low number of studies, the results for Egger’s test should be interpreted with caution.

3.4. Other outcomes

Of the 15 included studies, four (27%) reported that virtual care could result in time and cost savings with estimates in the range of 24–137 min and $60–67 per patient [40,44,45,49] (Table 2). Four studies (27%) reported a high success rate in using the information collected with virtual care, in the range of 92–100%, to diagnose and manage patients [12,38,40,47]. Two studies estimated the agreement for ASA classification between virtual care and in-person preoperative assessment to be in the range of 67–77% [41,46]. One study reported that 99.6% of patients were triaged correctly with virtual assessment [40]. One study reported that 100% of anesthesiologists were satisfied or highly satisfied with virtual care [38], while one study reported no difference in staff satisfaction [12]. Among studies which did not plan follow-up assessment in the protocol, 6% (range: 1–27%) of patients required further in-person evaluation following virtual preoperative assessment [38,40,42,46–49].

3.5. Quality assessment

The NOS scores of the 12 included cohort studies [16,39–49] ranged from 5 to 8 out of a possible score of 9 (Appendix: Table A4). Seven cohort studies were of low quality [16,39,40,42,47–49] and five were of high quality [41,43–46] according to Agency for Healthcare Research and Quality (AHRQ) standards. The NOS score of the included cross-sectional study [50] was 3 out of a possible score of 10, which was classified as unsatisfactory (Appendix: Table A5). Most studies did not ensure the comparability of the cohorts on the basis of design or by controlling for confounders [16,39,40,42,47–50]. The JBI critical appraisal checklists were used for the included case series [38] and randomized controlled trial [12], which had an overall score of 8 out of 10 and 11 out of 13, respectively, and resulted in an appraisal to include both studies (Appendix: Tables A6–A7).

4. Discussion

To the best of our knowledge, this is the first systematic review and meta-analysis to evaluate the effectiveness of virtual preoperative assessment in surgical patients. Compared to in-person evaluation, we found that virtual care resulted in similar surgery cancellation rates [12,16,39,43–45], with a pooled cancellation rate of 2%. Virtual preoperative assessment was able to prevent the inconvenience and frustration associated with day of surgery cancellations, and additional operating theatre, surgical staff, and travel costs [50]. Virtual care, moreover, provides the option to delay or cancel surgery remotely in favour of further optimization [50].

Virtual preoperative assessment resulted in a positive patient experience [38,39,41,44–46], with a pooled estimate of 90%. The high patient satisfaction with virtual care was largely attributed to an efficient and accurate preanesthesia evaluation, which reduced time and monetary costs associated with travel in the range of 24–137 min and $60–67 per patient [40,44,45,49], without increasing surgery cancellations [12,16,39,42–45]. In addition, many patients enjoyed the convenience of speaking to an anesthesiologist over a virtual platform, without having to take time off work to attend a separate preoperative clinic visit [39,52]. However, these findings may not be applicable for populations which have limited access to or have difficulty with technology, which may pose a barrier to the widespread adoption of telemedicine.

There was a high success rate in using the information collected with

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| Study         | Events | Total | Proportion  | 95%-CI         | Weight |
|---------------|--------|-------|-------------|----------------|--------|
| Rollert, 1999 | 0      | 35    | 0.00        | [0.00; 0.10]   | 2.4%   |
| Law, 2009     | 0      | 283   | 0.00        | [0.00; 0.01]   | 2.4%   |
| Zetterman, 2011 | 0    | 41    | 0.00        | [0.00; 0.09]   | 2.4%   |
| Bianco Vargas, 2012 | 120 | 6867 | 0.02        | [0.01; 0.02]   | 39.7%  |
| Roberts, 2015 | 0      | 29    | 0.00        | [0.00; 0.12]   | 2.4%   |
| Tam, 2017     | 7      | 229   | 0.03        | [0.01; 0.06]   | 19.1%  |
| Muller-Fortino, 2019 | 0   | 361   | 0.00        | [0.00; 0.01]   | 2.4%   |
| Kamdar, 2020  | 19     | 645   | 0.03        | [0.02; 0.05]   | 29.3%  |
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Random effects model

Estimates of the difference in surgery cancellation rates between virtual care and in-person assessment

Prediction interval

Heterogeneity: $I^2 = 45\%$, $p = 0.08$

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Fig. 2. Forest plot of surgery cancellation rates with virtual preoperative assessment. Abbreviations: CI, confidence interval; $I^2$, variation attributable to heterogeneity.

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virtual preoperative assessment, in the range of 92–100%, to diagnose and manage patients [12,38,40,47]. Patients were assessed by anesthesiologists, residents, nurses, and nurse practitioners in the included studies. However, there is a possible role for virtual preoperative evaluation by other healthcare workers, including family practitioners. It has been reported that virtual visits can facilitate detailed history taking, as patients may have increased access to their medications and documentation at home [44]. Virtual care may also play a role in triage to help prioritize more complex patients for in-person evaluation [40,46].

Although the adoption of virtual care has been accelerated due to the COVID-19 pandemic, comparable surgery cancellation rates to in-person visits and high patient satisfaction, coupled with reduced costs and accurate evaluations, demonstrate that virtual preoperative assessment can be used effectively to evaluate surgical patients. Virtual care helps to improve the delivery and accessibility of preanesthesia care, particularly for those with impaired mobility and in remote jurisdictions [50]. These findings are corroborated with other implementations of telemedicine during the COVID-19 pandemic, with a high degree of willingness from patients to continue using virtual care beyond the pandemic [53-56].

There was limited physical examination conducted with virtual care, with only 33% of studies having used electronic stethoscopes [12,38,40,47,50]. Even without the use of an electronic stethoscope, six studies reported similar or lower surgery cancellation rates compared to in-person evaluation [16,39,42-45]. In addition, there was a small proportion of patients who experienced connectivity issues who were less likely to report a preference for virtual care [44,46]. A focus on innovative solutions which incorporate elements of the physical examination and reduce the incidence of technical issues may facilitate an improved assessment, better patient experience, and further uptake of virtual preoperative evaluation.

In a multisite study, staff at institutions with a higher utilization of virtual preoperative assessment have reported an improvement of workflow and maintained quality of care [43]. At sites with a lower uptake, some staff believed that in-person visits offered better care for patients [43]. Although virtual care resulted in similar surgery cancellation rates compared to in-person evaluation and high patient satisfaction, future studies are needed to delineate the reasons underlying these perceptions.

4.1. Limitations

Our systematic review and meta-analysis has some limitations. First, there was no control group for four (27%) of the included studies [47-50], which limited the direct comparison between virtual care and in-person preoperative assessment outcomes. Second, only one study assessed patient experience using a validated questionnaire [41]. Third, the small number and incomplete reporting of included studies limited the use of subgroup analysis to explore the impact of potential confounders and may also limit the generalizability of findings. Fourth, there was limited data on perioperative complications and length of hospital stay [47,48]. Fifth, virtual preoperative evaluation was conducted by different types of healthcare workers at various levels of training. Finally, eight (53%) of the included studies were of low quality according to AHRQ standards. Given the limited number of high-quality studies and incomplete reporting of outcomes, further research is required, in particular with studies that ensure the comparability of virtual care and in-person cohorts through adequate randomization or adjustment for confounding factors.

5. Conclusions

This systematic review and meta-analysis demonstrates the utility of virtual care for preoperative assessment of surgical patients. Virtual preanesthesia evaluation had similar surgery cancellation rates, high patient satisfaction, and reduced costs compared to in-person evaluation.

Author contributions

Study concept and design: KZ, RW, FC. Literature search: ME. Acquisition, analysis, and interpretation of data: KZ, MR, RW, FC. Writing of manuscript: KZ, MR, RW, FC. Critical review and approval of manuscript: all authors. FC guarantees the integrity of the work.

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Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclinane.2021.110540.

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