Online video versus face-to-face preoperative consultation for major abdominal surgery (VIDEOGO): a multicentre, open-label, randomised, controlled, non-inferiority trial

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Summary

Background Online video consultation between patients and health-care providers rapidly gained popularity during the COVID-19 pandemic. However, to our knowledge, there is no high-quality comparative evidence regarding patient satisfaction and quality of information recall with online video consultation and traditional face-to-face consultation. This lack of evidence is especially concerning in the most demanding consultations. We aimed to assess whether online video consultation between patients and surgeons before major abdominal surgery was non-inferior to face-to-face consultation in terms of patient satisfaction, and to assess effects on patient information recall.

Methods This open-label, randomised, controlled, non-inferiority trial (VIDEOGO) was conducted at two hospitals (one academic and one regional) in the Netherlands. Adult patients (aged ≥18 years) who required consultation with a surgeon to discuss major abdominal surgery and were able and willing to interact via both online video and face-to-face consultation were eligible for inclusion; patients were excluded if they were unable or unwilling to start or maintain online video consultation. Eligible patients were randomly allocated (1:1) to online video or face-to-face consultation by the study coordinator, using a computer-generated, concealed, permuted-block randomisation method with varying block sizes (two, four, and six patients), stratified by study site. Masking of patients and health-care providers was not possible owing to the nature of the study. The primary outcomes were patient satisfaction (score 0–100; assessed for non-inferiority with a predefined margin of –10%) and information recall (score 0–11), both of which were assessed with online questionnaires and analysed in the intention-to-treat population for whom outcome data were available. Technical adverse events were assessed directly after the consultation as part of the satisfaction questionnaire. This trial is registered with the International Clinical Trial Registry Platform and the Central Committee on Research Involving Human Subjects registry, NL-OMON20092, and is complete.

Findings Between Feb 13, 2021, and Oct 2, 2023, 120 patients were randomly assigned: 60 to online video consultation and 60 to face-to-face consultation. Outcome data were available for 57 patients in the online video consultation group (20 [35%] female and 37 [65%] male; median age 64·0 [54·5–72·5] years) and 55 patients in the face-to-face group (22 [40%] female and 33 [60%] male; median age 62·0 [56·0–70·0] years). The mean patient satisfaction score was 85·4 out of 100 (SD 12·3) in the online video consultation group and 85·2 (14·2) in the face-to-face group (mean difference 0·2, 95% CI –4·8 to 5·1), which was within the non-inferiority margin of –10% ($p_{non\text{-}inferiority}<0·0001$). The mean information recall score was 7·30 out of 11 (SD 1·60) in the online video consultation group and 7·25 (1·48) in the face-to-face group (mean difference 0·05, 95% CI –0·53 to 0·63). Technical adverse events occurred for two (7%) of 29 patients for whom data were available: one patient experienced a problem with the video connection and one experienced a problem with audio, both of which were resolved during the consultation without affecting the conversation.

Interpretation The use of online video consultation during surgical consultation for major abdominal surgery was non-inferior to face-to-face consultation in terms of patient satisfaction and did not substantially affect information recall. These findings suggest that online video consultation can be implemented confidently in surgical outpatient clinics.

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Introduction

Patient consultation in the surgical outpatient setting is essential to explain and discuss procedures, associated risks of complications, harms and benefits of surgery, and alternative options. This patient–surgeon or patient–doctor interaction has typically occurred through face-to-face

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Research in context

Evidence before this study

We searched PubMed, Embase, and Web of Science Core Collection to identify studies published in English between database inception and Nov 29, 2024. We used the search terms "video consultation" and "surgery", including synonyms, closely related words, and keywords, either as index terms or free-text words. We included randomised controlled trials (RCTs), non-randomised controlled trials, and prospective and retrospective comparative studies on patient and surgeon satisfaction, information recall, and efficacy (ie, time, distance travelled, and costs) of online video consultation versus face-to-face patient–surgeon consultation. We identified 15 studies comprising eight RCTs, three prospective studies, and four retrospective studies, including a total of 13 664 patients. Of these, ten studies reported similar patient satisfaction rates and five studies reported similar surgeon satisfaction rates between online video consultation and face-to-face consultation. Data on efficacy outcomes were provided by eight studies, including three RCTs indicating that online video consultation significantly reduced waiting time and total appointment duration compared with face-to-face consultation. All studies assessed low-demand follow-up surgical consultations; none assessed high-demand pre-surgical consultations or patient information recall.

Added value of this study

To our knowledge, this RCT is the first to compare online video consultation with face-to-face consultation, in terms of patient and surgeon satisfaction and information recall, in patients who required pre-surgical consultation with a surgeon to discuss major abdominal surgery. Such high-demand consultations require extensive and precise information transfer and well adjusted emotional support. This trial showed that online video consultation is non-inferior to face-to-face consultation in terms of patient satisfaction, and our results indicated that the quality of patient information recall was not reduced as a result of online video consultation. Furthermore, analysis of secondary outcomes showed that online video consultation decreased travel and waiting times for patients, in addition to reducing costs and carbon footprint.

Implications of all the available evidence

On the basis of these results, online video consultation can be offered to eligible patients requiring consultation with a surgeon to discuss major abdominal surgery, without affecting the quality of information recall and offering improvements in terms of time, cost, and environmental impact.

consultation. However, the COVID-19 pandemic challenged this model and prompted a rapid shift from face-to-face consultation to online video consultation to ensure continued access to essential care.[1] Before the COVID-19 pandemic, online video consultation had been developed in several countries where low population densities led to challenges in access to health care (eg, Norway and Finland).[2] By facilitating verbal communication while preserving non-verbal cues, online video consultation offers unique advantages—such as equalising access to health care—without the need for travel and associated costs.[3] Technical facilities through which to provide online video consultation have increased rapidly over the past 5 years, since the COVID-19 pandemic.

In the current post-pandemic era, online video consultation could continue to benefit both patients and health-care providers as a method of choice for outpatient consultation. In particular, online video consultation could ensure health-care access for patients facing travel challenges or distance barriers from providers.[4] Other potential benefits over face-to-face consultation include reduced travel expenses and a lower carbon footprint associated with a reduced need for health-care-related travel.[5]

Although various online video consultation strategies have been shown to be feasible in different care-provider contexts,[6–9] some potential barriers require consideration.[10] These barriers include limitations in the conduct of physical examinations, digital health literacy issues, technical issues, and health literacy challenges.[11] Evaluation of the balance between the benefits and harms of online video consultation compared with face-to-face consultation is especially important when explaining major abdominal surgical procedures to patients, which is a legal requirement for obtaining consent.[12] A large survey in patients undergoing orthopaedic and trauma surgery concluded that, outside the setting of a pandemic, face-to-face consultation remains the method of choice for most patients.[13] However, the feasibility, benefits, and limitations of online video consultation compared with face-to-face consultation for this type of consultation are poorly studied to date. Although previous randomised controlled trials, prospective studies, and retrospective studies have compared online video consultation and face-to-face consultation in terms of patient and surgeon satisfaction for low-demand, follow-up surgical consultations, to our knowledge there have been no randomised controlled trials assessing the use of online video consultation for high-demand, pre-surgical consultations or assessing patient information recall after such consultations.[5–7,11,14–26]

The VIDEOGO trial aimed to assess whether online video consultation is non-inferior to face-to-face consultation for preoperative surgical consultation before major abdominal surgery in terms of patient satisfaction, as well as assessing effects on patient recall, surgeon satisfaction, time, costs, and carbon footprint.

Methods

Study design and participants

VIDEOGO was a multicentre, open-label, randomised, controlled, non-inferiority trial, conducted at two hospitals

(one academic and one regional) in the Netherlands: at both locations (Amsterdam Medical Center and Vrije Universiteit Medical Center) of the Amsterdam University Medical Center (UMC), Amsterdam; and at the Catharina Hospital, Eindhoven.

Adult patients (aged ≥18 years) who required consultation with a surgeon to discuss major abdominal surgery (eg, hemihepatectomy, pylorus preserving or resecting pancreatoduodenectomy, or oesophagectomy; appendix p 41), and who were able and willing to interact with their surgeon via both online video consultation and face-to-face consultation, were eligible for inclusion. Patients were excluded if they had no access to an electronic device or internet connection, were unable or unwilling to start or maintain online video consultation with their surgeon, were not willing or able to activate and log in to the electronic patient portal, had insufficient sight or hearing, faced an unsurpassable language barrier, or had cognitive impairment.

Patients were screened during multidisciplinary team meetings that included surgeons, medical oncologists, pathologists, radiologists, gastroenterologists, nurse practitioners, and the local study coordinators (BHEAtH and BVJ). Patients were informed about the study at the outpatient clinic followed by additional explanation from the study coordinators (BHEAtH and BVJ), mostly by telephone or otherwise in person. Written informed consent was obtained from patients by e-mail. Demographic data, self-reported by the participants, were collected at research screening.

The study protocol was primarily reviewed by the institutional review board at Amsterdam UMC, which confirmed that the Medical Research Involving Human Subjects Act did not apply because of the estimated minimal effect on patients and, therefore, official approval was not required. This study was conducted in accordance with the principles of the Declaration of Helsinki[27] and the CONSORT guidelines.[28] The study protocol is available in the appendix.

Randomisation and masking

Patients were randomly allocated (1:1) by the study coordinators (BHEAtH and BVJ) to online video consultation or face-to-face consultation. Randomisation was done centrally though a web-based system (Castor EDC, Amsterdam, Netherlands), using a computer-generated, concealed, permuted-block randomisation with varying block sizes (two, four, and six patients), stratified by study site. Because of the nature of this study, the masking of patients and health-care providers was deemed not possible.

Procedures

Software enabling a secure video connection was used at both Amsterdam UMC locations (initially from Vidyo, Hackensack, NJ, USA; later replaced by Microsoft Teams, Microsoft Corporation, Redmond, WA, USA) and at the Catharina Hospital, Eindhoven (Microsoft Teams throughout). Online video consultation was integrated into the electronic health record systems at all study sites. This integration was facilitated using Epic software (Epic Systems Corporation, Verona, WI, USA) and the electronic patient portal MyChart at Amsterdam UMC and using HiX (ChipSoft, Amsterdam, Netherlands) and the electronic patient portal MyCatharina at the Catharina Hospital, allowing for safe online video consultation. Because the video software was integrated within the electronic health record at all study sites, confidentiality was ensured through the hospital's standardised regulations according to the General Data Protection Regulation guidelines (the portal was protected by a personal two-factor-verification login). Health-care providers could start a video connection by accessing the electronic health record through either Epic or HiX at a clinical workstation. Alternatively, at Amsterdam UMC, providers could also use EpicCare's (Epic Systems Corporation, Verona, WI, USA) mobile apps to establish a video connection, initially only using Canto for iOS but later also using Haiku for Android. At a clinical workstation, online video consultation was conducted using a full high-definition LifeCam Studio webcam (Microsoft Corporation, Redmond, WA, USA). In addition, if desired, a Mini Tripod (Eastman Kodak Company, Rochester, NY, USA) was available to enable drawings of the surgical procedure to be displayed during the consultation, as well as portable speakers with input and output audio or a Beats (Apple, Cupertino, CA, USA) headset (for a standard setup, see appendix p 2). The use of Canto or Haiku allowed clinicians at Amsterdam UMC to access patient charts securely from their own mobile devices. For all patients, the virtual waiting room was accessible 10 min before online video consultation. After random assignment to online video consultation, at the two Amsterdam UMC locations, explanation of how to create a MyChart account and how to conduct the consultation was sent to the patient by email by the online video consultation support team—a local team created during the COVID-19 pandemic that helped with the implementation and use of online video consultation and was available for patients, clinicians, and the study coordinator. At the Catharina Hospital, Eindhoven, additional support for patients—including explanation of how to create a MyCatharina account and how to conduct online video consultation—was given by the clinician or local study coordinator. Patients were mostly seen at dedicated multidisciplinary clinics for specific conditions (eg, pancreatic malignancy, liver malignancy, or oesophagogastric malignancy) and often had multiple appointments on the same day after the multidisciplinary team meeting. Patients who, after a full investigation, were given advice regarding their surgical treatment on the same day did not participate in the study and received direct face-to-face preoperative consultation. Patients for whom more diagnostic tests were required—and, consequently, for whom the surgical consultation had to be postponed—could participate in the study. Patients specifically referred for a surgical consultation (eg, by gastroenterologists), typically

See Online for appendix

after a previous multidisciplinary meeting, were also able to participate. As a result, some patients did not meet the surgeon before the trial consultation, whereas others had met and spoken to the surgeon face-to-face previously. For most patients, consultation was with a surgeon; a small number of patients had their consultation with a nurse practitioner.

After randomisation, patients were asked to complete four questionnaires: two before and two after the consultation (appendix pp 3–40). All questionnaires were selected with the help of OCD and MCdB, who are experts on patient communication, health literacy, and patient centredness in relation to quality of care. Before the consultation, patients were required to complete a digital health literacy questionnaire[29] and the newest vital sign questionnaire[30] that assesses general literacy in health-care settings (health literacy); the results of both questionnaires contributed to the patient demographic information and the subgroup analysis (for scoring calculations, see appendix pp 6–7). After the consultation, patients were asked to complete the Patient Satisfaction Questionnaire (PSQ)-NL (a shortened version of the PSQ-18 questionnaire translated into Dutch,[31] scored from 0–100 on a visual analogue scale) and a custom questionnaire to test information recall within 48 h after the consultation. Because a consultation included an explanation of major surgical procedures, the information-recall questionnaire consisted of nine items questioning different aspects of the explained procedure. This questionnaire was a custom-made, non-validated questionnaire, with the aim of comparing outcomes between online video consultation and face-to-face consultation. Surgeon satisfaction was assessed using the PSQ physician questionnaire (score range 0–100 on a visual analogue scale). All questionnaires were sent to patients and surgeons by email on the same day as the appointment and responses were collected using SurveyMonkey (SurveyMonkey, San Mateo, CA, USA), with the exception of the newest vital sign questionnaire[30] assessing health literacy, which was conducted by the study coordinator by telephone. If patients or surgeons had not completed questionnaires within 48 h after the consultation, they received multiple email reminders, and an additional telephone reminder if necessary, from the study coordinator. Scoring was done in accordance with the instructions previously defined in the study protocol (appendix pp 32, 36).

Costs per online video consultation were calculated as follows: hours of electricity usage × wattage of the computer × cost per kilowatt-hour (kWh); a 30-min consultation with an average laptop power consumption of 100 watts and a cost of €0·27 per kWh was assumed.[32,33] To calculate the cost of a face-to-face consultation, fuel costs of €0·23 per km[34] were added to parking costs for a 30 min consultation plus time in the waiting room (average per hospital site: €3·53 per 60 min); if the exact time in the waiting room was unknown, the median waiting time was used. The carbon footprint of online video consultation was calculated by determining the equivalent CO_2 emissions (CO_2eq) in grams (g) resulting from a combination of electricity and internet use per min, assuming an average of 30 min per consultation. For face-to-face consultation, carbon footprint was calculated, with the assistance of an environmental expert (WJKH), using online calculation tools with average CO_2eq emission per km based on the Dutch STREAM study.[35] In calculating the total carbon footprint and travel costs per patient receiving face-to-face consultation, 100% of patients were assumed to travel by fossil fuel car.

Outcomes

Primary outcomes were patient satisfaction, assessed using the PSQ-NL, and information recall, assessed using a custom, non-validated questionnaire. Secondary outcomes were surgeon satisfaction, assessed using the PSQ physician questionnaire, time (including travel and waiting time for face-to-face consultation and start-up and waiting time for online video consultation), distance travelled (calculated as the twice the number of kilometres [km] between the hospital site and the patients' primary address as registered in the Electronic Patient Record system, to account for travel to and from the appointment), costs, and carbon footprint.

Technical adverse events were evaluated using the evaluation process efficacy questionnaire as a second part of the PSQ-NL or PSQ physician questionnaires, consisting of three (for face-to-face consultation) or six (for online video consultation) additional questions; the six additional questions for online video consultation included three questions on technical adverse events.

All outcomes were centrally assessed by the study coordinator (BHEAtH).

Statistical analysis

The sample size was calculated using nQuery version 8.5.1.0, for a two-group *t*-test of non-inferiority of means, to assess non-inferiority of online video consultation to face-to-face consultation in terms of patient satisfaction. The non-inferiority margin was defined as –10% (10 points out of 100). With an SD of 20·0 (a conservative estimate based on an unpublished pilot study, conducted by our research group, in 50 patients), a difference of 10·0 resembled an effect size of 10·0 / 20·0=0·50. With the expectation that online video consultation would score 3·0 points higher than face-to-face consultation in terms of patient satisfaction, based on the results of the pilot study (in which mean scores were 88·0 [SD 8·0; n=21] for online video and 85·0 [17·0; n=29] for face-to-face consultation) and a one-sided significance level of 2·5%, a sample size of 51 patients in each group had 90% power of detecting non-inferiority. For information recall, no clear predefined non-inferiority margin could be established owing to the absence of previous data; we therefore used the same margin (–10%) as for patient satisfaction. With an expected moderate dropout rate of 15% based on non-response to questionnaires, 120 patients were needed for randomisation.

All patients who received a consultation and had outcome measure data available were included in the intention-to-treat analysis; the per-protocol analysis included all patients who received the intended consultation for their assigned group and had outcomes measure data available. Patients who, after initial randomisation, became ineligible or unable to complete the primary outcome questionnaires owing to factors such as disease progression (rendering them ineligible for surgery) or early death, as well as patients who withdrew from participation in the study, were excluded from the analyses and were subsequently replaced to ensure that an adequate level of statistical power was maintained.

Patient satisfaction and information recall were assessed for non-inferiority (–10% margin) based on the mean difference and 95% CI, as estimated by Student's *t*-test. Online video consultation was considered non-inferior when the lower bound of the two-sided 95% CI was larger than the non-inferiority margin. A p value for non-inferiority was generated using a one-sided equivalence test. As a post-hoc sensitivity analysis, the adjusted mean difference was estimated using multivariable linear regression analysis for both primary outcomes (patient satisfaction and information recall) to adjust for potentially prognostic variables. In this analysis, all baseline characteristics (age, sex, American Society of Anesthesiologists [ASA] physical status, type of surgery, health literacy, and digital health literacy [using the sum of self-reported and performance-based outcomes]) were included as potential predictors in the linear model and backward selection was applied. Furthermore, the regression analysis was adjusted for stratification factor (study site), irrespective of the p value of this variable in the multivariable model. All other outcomes were given as mean (SD) when normally distributed or median (IQR) in the case of a non-normal distribution, and compared using Student's *t*-test or the Mann–Whitney *U*-test, respectively. Normality of the distribution was assessed by visually inspecting histograms and boxplots. Categorical variables were reported as frequencies with percentages. Analyses were done using χ^2 tests or Fisher's exact tests in the case of small sample sizes. Surgeon satisfaction was compared using a *t*-test to estimate mean differences and 95% CIs; however, surgical satisfaction was not formally tested for superiority or non-inferiority. Differences in terms of time, costs, and carbon footprint between the two groups were assessed for superiority. Additionally, we estimated the mean difference in patient satisfaction in the following subgroups: patients 70 years or older, patients with a health literacy[36] score of less than 4, and patients with low digital health literacy skills (by excluding patients with high digital health literacy scores; as there is no validated cutoff value, we assumed low digital health literacy for scores equal to and lower than the median performance on the digital health literacy questionnaire and high digital health literacy for scores higher than the median). Non-inferiority was not formally tested in these subgroup analyses, as the trial was not adequately powered to estimate treatment effects within individual subgroups and test for treatment-effect heterogeneity between subgroups using treatment–covariate interactions. A post-hoc sensitivity analysis was conducted for type of surgery and late responses (ie, when questionnaires were completed more than 7 days after the consultation). Significance was defined at a two-sided p value of less than 0·05. All statistical analyses were conducted using SPSS Statistics (2020) and in consultation with a senior epidemiologist (SvD). Non-inferiority testing was conducted using R version 3.4.2 with the TOSTER package. This trial is registered with the International Clinical Trial Registry Platform and the Central Committee on Research Involving Human Subjects registry, NL-OMON20092, and is complete.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Between Feb 13, 2021, and Oct 2, 2023, 263 patients were assessed for eligibility, of whom 120 were randomly assigned (1:1) to either the online video consultation group (n=60) or the face-to-face consultation group (n=60). After randomisation, 15 participants (six in the online video consultation group and nine in the face-to-face group) were excluded and replaced in accordance with the study protocol, owing to ineligibility for surgery (n=7), physical decline hindering completion of the questionnaire (n=3), withdrawal of consent (n=4), and a rescheduled appointment (n=1). One patient in the online video consultation group and five patients in the face-to-face group did not respond to questionnaires and were excluded from analysis; additionally, two patients in the online video consultation group were excluded from analysis as they received a telephone consultation instead of an online video consultation. One patient allocated to the online video consultation group received a face-to-face consultation instead. The final intention-to-treat analysis comprised 57 patients in the online video consultation group (37 [65%] male and 20 [35%] female; median age 64·0 [54·5–72·5] years) and 55 patients in the face-to-face group (22 [40%] female and 33 [60%] male; median age 62·0 [56·0–70·0] years; figure 1). Baseline characteristics did not differ substantially between groups (table 1). Of these 112 patients, 81 (72%) were receiving consultations for hepato-pancreato-biliary surgery, 18 (16%) for upper-gastrointestinal surgery, and 13 (12%) for other types of major (abdominal) surgery (12 for fundoplication and one for total thyroidectomy). Additional baseline characteristics of the intention-to-treat population, including all types of surgery, are shown in the appendix (p 41).

All 112 (100%) patients completed the patient satisfaction questionnaire. The mean total patient satisfaction scores were 85·4 out of 100·0 (SD 12·3) in the online video consultation

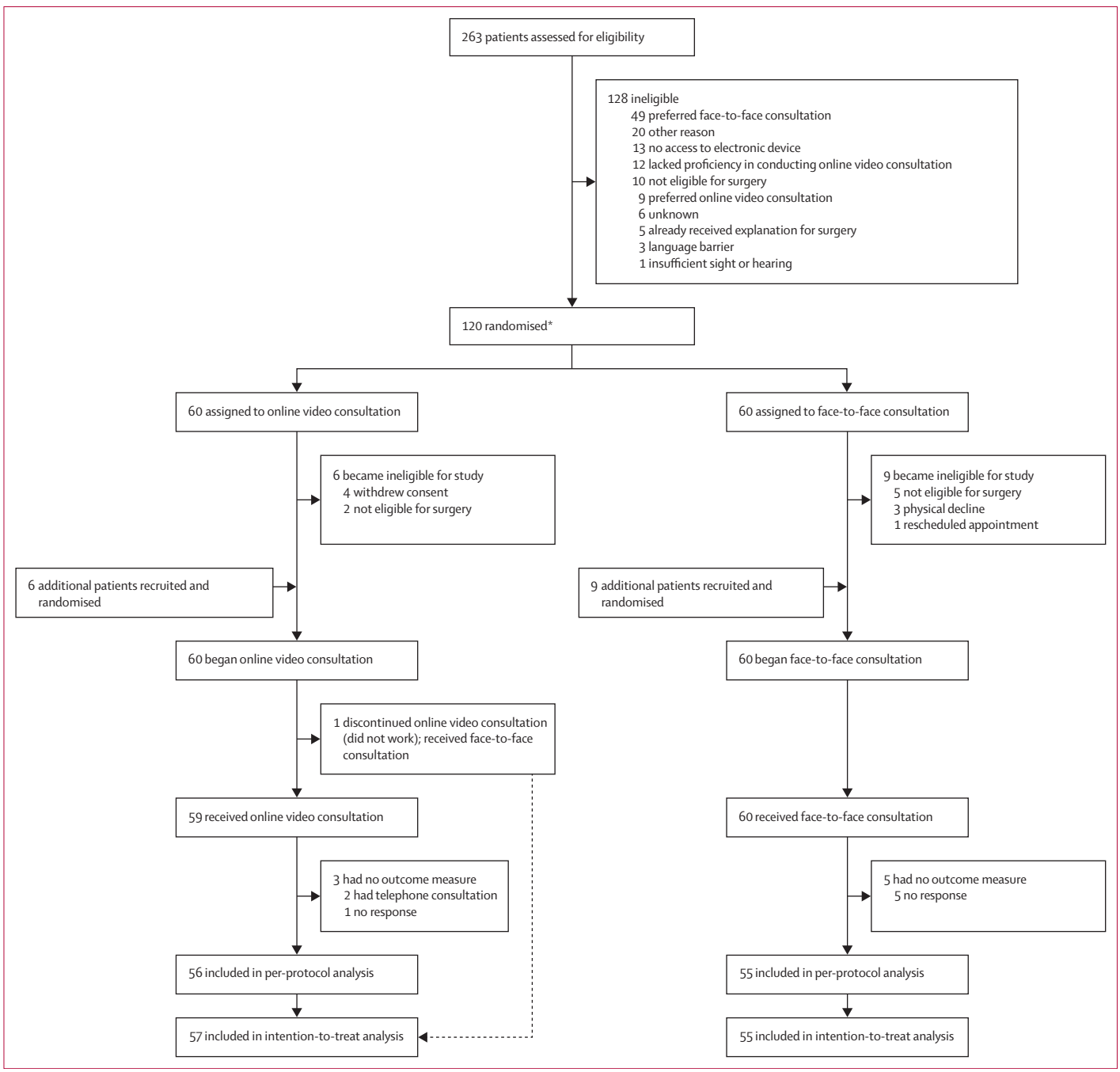

Figure 1: **Trial profile**
*Excluding 15 patients who were replaced.

group and 85·2 out of 100·0 (SD 14·2) in the face-to-face group (mean difference 0·2, 95% CI −4·8 to 5·1), well within the non-inferiority margin ($p_{non\text{-}inferiority}<0·0001$; figure 2). The adjusted mean difference was 0·2 (−4·8 to 5·1; appendix p 42); this linear regression analysis was adjusted only for the stratification factor (study site), as none of the baseline characteristics were identified as significant predictors of patient satisfaction after backward selection. Because only one patient crossed over from online video consultation to face-to-face consultation, the per-protocol analysis gave the same results as the intention-to-treat analysis. In the subgroup analysis for age (ie, excluding patients aged <70 years), numerically similar scores were seen for online video consultation and face-to-face consultation, with mean patient satisfaction scores of 81·8 (SD 11·3) in the online video consultation group and 84·4 (10·9) in the face-to-face group

(mean difference –2·6, 95% CI –10·5 to 5·4). Patient satisfaction scores were numerically similar in the subgroup of patients with low health literacy scores (83·6 [12·2] for the online video consultation group *vs* 86·9 [12·8] for the face-to-face group; mean difference –3·3, 95% CI –12·0 to 5·5) and in the subgroup of patients with low digital health literacy scores (81·6 [14·3] *vs* 81·8 [16·1]; –0·2, –9·6 to 9·3; appendix p 43). Overall, 17 (15%) of 112 patients completed their patient satisfaction questionnaires more than 7 days after the consultation. In a post-hoc sensitivity analysis excluding these 17 late responses, non-inferiority of online video consultation was maintained, with scores of 87·1 (10·8) in the online video consultation group versus 87·0 (12·0) in the face-to-face group (0·1 [–4·6 to 4·7]; appendix p 44). Given the dominance of hepato-pancreato-biliary surgery (undergone by 63% of patients in the online video consultation group and 82% in the face-to-face group), we also conducted a post-hoc sensitivity analysis for type of surgery, in which online video consultation remained non-inferior with scores of 85·3 (12·2) in the online video consultation group versus 85·5 (14·6) in the face-to-face group (–0·2 [–6·2 to 5·9]).

Regarding information recall, 111 (99%) of 112 patients completed the questionnaire (table 2), 28 (25%) of whom did so more than 7 days after the consultation. The mean scores were 7·30 out of 11 (SD 1·60) in the online video consultation group and 7·25 (1·48) in the face-to-face consultation group (mean difference 0·05, 95% CI –0·53 to 0·63). The adjusted mean difference was 0·14 (–0·41 to 0·69), adjusted for sex, ASA physical status, health literacy, digital health literacy, type of surgery, and study site (stratification factor; appendix p 42). In the post-hoc sensitivity analysis excluding the 28 late responses, the mean scores were 7·4 (1·6) in the online video consultation group and 7·4 (1·4) in the face-to-face group (0·04, –0·60 to 0·68)—similar to those of the main analysis (appendix p 44).

The surgeon satisfaction questionnaire was completed for 110 (98%) of 112 consultations. The mean total surgeon satisfaction scores were 76·9 out of 100·0 (SD 10·9) in the online video consultation group and 78·5 (8·4) in the face-to-face group (mean difference –1·6, 95% CI –5·3 to 2·1; appendix p 45). The only notable difference was observed for how actively patients' relatives were involved in the conversation, which scored lower in the online video consultation group (64·9 [28·9]) than in the face-to-face group (76·7 [11·6]; –11·8, –20·3 to –3·2).

Questions regarding start-up, travel, and waiting times were completed by 56 (47%) of 112 patients. The median start-up time for online video consultation was 5·0 min (IQR 2·0–9·0), versus 120·0 min (60·0–180·0) travel time for face-to-face consultation (p<0·0001; figure 3). The median duration spent in the virtual waiting room was 10·0 min (IQR 3·0–17·5) for online video consultation versus 15·0 min (10·0–30·0) in the hospital waiting room for face-to-face consultation (p=0·016).

Data on distance travelled, carbon footprint, and costs per consultation were available for all 112 (100%) patients (figure 3). The median distances travelled were 0 km (no ranges were associated with this estimate as it was assumed for all patients) in the online video consultation group and 67·8 km (IQR 44·4–116·0) in the face-to-face group (p<0·0001). The mean CO_2 emission per consultation in the online video consultation group was 93 g CO_2eq (SD 0) versus 7783 g CO_2eq (IQR 5097–13 317) per consultation for face-to-face consultation (p<0·0001), equal to a 99% CO_2 reduction in the case of online video consultation. The total cost to the patient of conducting an online video consultation was €0·01 (SD 0·0; electricity costs) versus €17·9 (IQR 14·2–29·3; fuel and parking costs) for face-to-face consultation (p<0·0001).

Results regarding technical adverse events were available from 23 surgeon questionnaires (some of which could have been completed by the same surgeon, if they conducted multiple consultations) and 29 patients in the online video consultation group, from a total of 57 consultations. Two (7%) of 29 patients reported issues: one problem with the video connection and one problem with audio. Both (100%) problems were resolved during the consultation without affecting the conversation. 25 (86%) of 29 patients and 21 (91%) of 23 surgeon questionnaires in the online video consultation group would recommend online video consultation to their close relatives. The main advantages mentioned were the absence of travel time, reduced travel costs, and easier planning. None of the patients in the online video consultation group specifically requested an additional face-to-face consultation for further explanation after online video consultation. Opinions on online video consultation from the face-to-face consultation group were

	Online video consultation (n=57)	Face-to-face consultation (n=55)
Sex		
Female	20 (35%)	22 (40%)
Male	37 (65%)	33 (60%)
Age, years	64·0 (54·5–72·5)	62·0 (56·0–70·0)
ASA physical status		
I (normal healthy patient)	1 (2%)	3 (6%)
II (mild systemic disease)	30 (55%)	35 (67%)
III (severe systemic disease)	24 (44%)	14 (27%)
Type of surgery		
Hepato-pancreato-biliary surgery	36 (63%)	45 (82%)
Upper-gastrointestinal surgery	14 (25%)	4 (7%)
Other major (abdominal) surgery	7 (12%)	6 (11%)
Independency		
Yes*	21/27 (78%)	21/29 (72%)
No	6/27 (22%)	8/29 (28%)
Health literacy†	5·0 (3·0–6·0)	4·0 (3·0–6·0)
Digital health literacy		
Self-reported‡	3·1 (2·8–3·5)	3·2 (2·8–3·5)
Performance-based§	5·5 (3·5–6·1)	5·5 (3·5–6·0)

Data are n (%), n/N (%), or median (IQR). ASA=American Society of Anesthesiology. *Defined as being able to conduct the consultation without any help, data available for 56 patients. †Score range 0–6, maximum score 6. ‡Score range 1–4, maximum score 4. §Score range 0–7, maximum score 7.

Table 1: **Baseline characteristics of the intention-to-treat population**

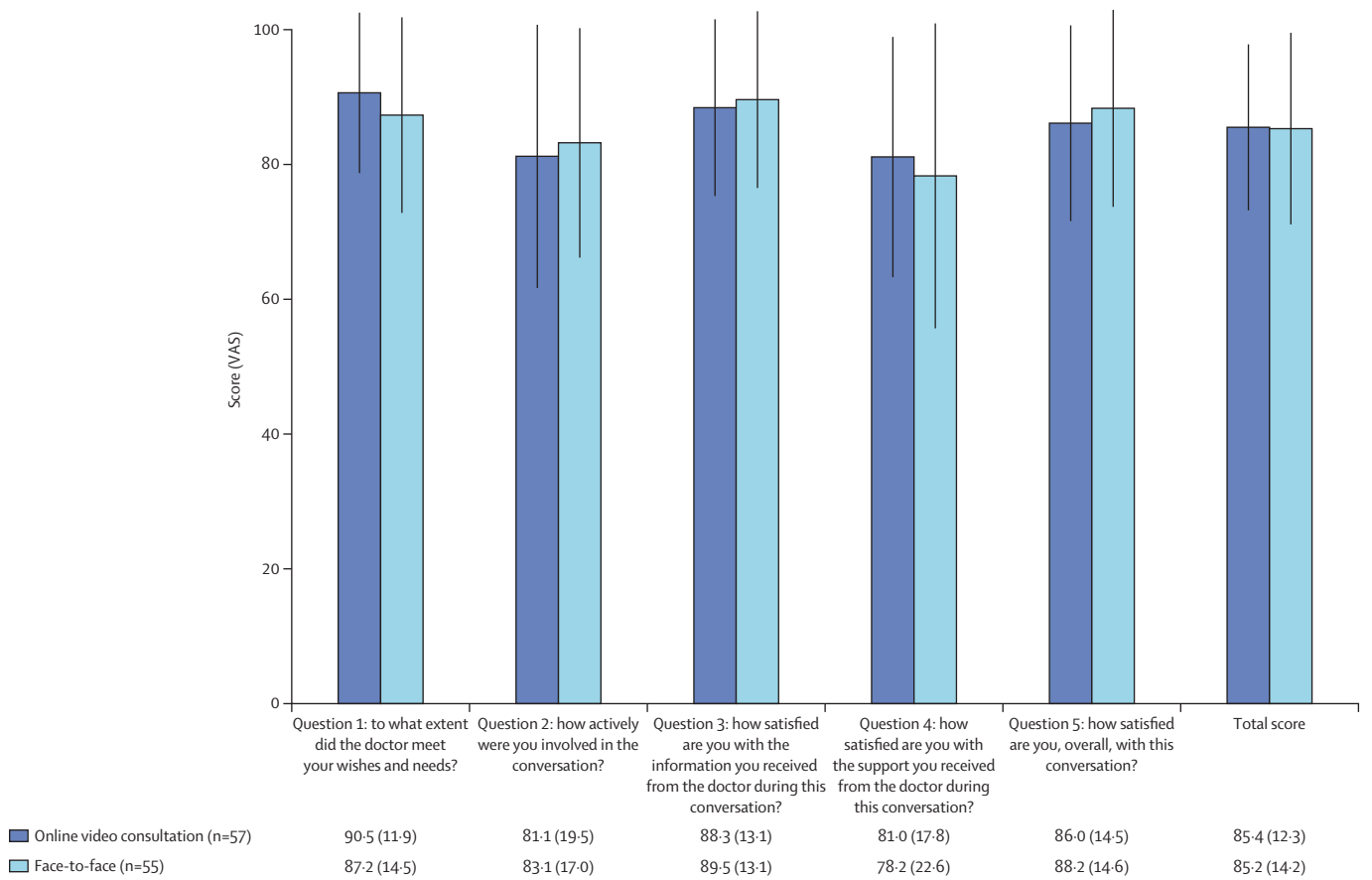

Figure 2: **Patient satisfaction with online video consultation versus face-to-face consultation for major abdominal surgery**
The box height represents the mean and the vertical lines show the SD. VAS=visual analogue scale.

available from 25 surgeon questionnaires and 27 patients from a total of 55 face-to-face consultations. In this group, 12 (44%) of 27 patients and 22 (88%) of 25 surgeons indicated that their face-to-face consultation could have been conducted online via video. The primary reasons cited for indicating that a face-to-face consultation could not have been replaced by online video consultation were the desire for personal contact and the surgeon's use of drawings during the consultation. Previous contact between the surgeon and the patient was often mentioned, by both patients and surgeons, as an important prerequisite for online video consultation. No patients refused surgery after online video or face-to-face consultation.

Discussion

In this multicentre, open-label, randomised, controlled, non-inferiority trial (VIDEOGO), we compared online video consultation with face-to-face pre-surgical consultation in patients who required consultation with a surgeon to discuss major abdominal surgery, and found online video consultation to be non-inferior in terms of patient satisfaction, without substantially affecting patient information recall or surgeon satisfaction. Online video consultation was also superior to face-to-face consultation in terms of time spent, cost, distance travelled, and carbon footprint.

These findings align with previous research regarding patient and surgeon satisfaction with online video consultation for less-challenging, routine postoperative follow-up.[15,26] A 2023 randomised controlled trial from the USA[6] reported non-inferior patient satisfaction scores (80·7 [SD 2·6] for online video consultation *vs* 81·2 [2·8] for face-to-face consultation) in 52 women during follow-up after reconstructive pelvic surgery. In total, eight previous studies[6,7,11,16,19,21,23,26] addressed satisfaction rates for online video consultation and face-to-face consultation in surgical patients. Of these, seven studies reported similar satisfaction rates (80–96% for online video consultation *vs* 65–94% for face-to-face consultation) and one study reported higher satisfaction with online video consultation (92%) than with face-to-face consultation (63%; p=0·04). However, these studies primarily focused on preoperative (ie, anaesthetic) assessments or postoperative follow-up consultations, and did not include the highly demanding preoperative surgical consultation that is required to obtain informed consent.

	Online video consultation (n=56)	Face-to-face consultation (n=55)	Mean difference (95% CI)
Question 1: why are you undergoing surgery? (Maximum 1 point.)	0·95 (0·23)	0·91 (0·29)	0·04 (–0·06 to 0·14)
Question 2: which organs or structures are you being operated on? (Maximum 1 point.)	0·98 (0·13)	1·00 (0)	–0·02 (–0·05 to 0·02)
Question 3: are you having an open or a minimally invasive surgery? (Maximum 1 point.)	0·91 (0·29)	0·91 (0·29)	0·00 (–0·11 to 0·11)
Question 4: how long is the waiting time for your operation? (Maximum 1 point.)	0·91 (0·29)	0·85 (0·36)	0·06 (–0·07 to 0·18)
Question 5: how many days do you need to stay in the hospital after your surgery if there are no complications? (Maximum 1 point.)	0·93 (0·26)	0·93 (0·26)	0·00 (–0·10 to 0·10)
Question 6: in the case of no complications, how many months will it take until you are largely recovered? (Maximum 1 point.)	0·59 (0·50)	0·75 (0·44)	–0·16 (–0·33 to 0·02)
Question 7: list four potential complications of the surgery. If known, include your likelihood of experiencing them. (Maximum 2 points.)	0·94 (0·70)	0·71 (0·59)	0·23 (–0·02 to 0·47)
Question 8: name two potential long-term complications or symptoms that may occur after the surgery. If known, include your likelihood of experiencing them. (Maximum 2 points.)	0·43 (0·35)	0·36 (0·34)	0·07 (–0·06 to 0·20)
Question 9: how likely is it that you will die due to potential complications related to your surgery? (Maximum 1 point.)	0·66 (0·48)	0·85 (0·36)	–0·19 (0·03 to 0·35)
Total score. (Maximum 11 points)	7·30 (1·60)	7·25 (1·48)	0·05 (–0·53 to 0·63)

Data are mean (SD) or mean difference (95% CI).

Table 2: **Information recall scores for online video consultation and face-to-face consultation before major abdominal surgery**

In this study, the only downside of online video consultation cited by surgeons was a reduced ability to involve patients' relatives. This finding could be attributed to surgeons not yet being familiar with online video consultation or to technical challenges in the early stages of its use. Another explanation might be that relatives were present but not visible on screen, or that they were simply not present, which might be reported by the surgeon as reduced involvement of relatives because there was no option in the questionnaire to report their presence or absence. Additionally, patients might have been unaware of the option to involve a relative, although they were able to join the consultation by simply sitting next to the patient. Furthermore, most online video consultation systems (ie, current business video applications) now allow for the invitation of others (eg, relatives) to dial in during the consultation. This option should be better highlighted and used. Moreover, previous research indicated that patients particularly appreciated online video consultation because relatives could easily participate in the consultation.[10]

For patients, online video consultation saves time and money compared with face-to-face consultations. Previous randomised controlled trials conducted in a surgical follow-up setting have reported similar findings to the results of this study regarding start-up or travel time and waiting time in the hospital or virtual waiting room.[5–7] Results on patient costs vary, mainly because of differences in the calculation of costs. A 2022 randomised controlled trial from Germany[5] reported total patient-focused costs for follow-up appointments of €16 for an employed patient in the telemedicine (online video consultation and telephone) group and €93 for an employed patient in the face-to-face group, with some of this cost attributed to production losses (for unemployed patients, costs were €6 *vs* €60).[5] In the current study, production losses were not taken into account owing to large heterogeneity (including variation in physical performance status) and the presence of many retired patients. Nonetheless, independent of the exact variables considered, online video consultation is more efficient than face-to-face consultation in terms of carbon footprint in all existing studies;[5] in our study, the carbon footprint was also significantly lower in the online video consultation group than in the face-to-face consultation group. Because online video consultation was found to be acceptable for major abdominal surgery, its use in other applications (eg, minor abdominal surgery, other surgeries, and non-surgical consultations) could also be acceptable and could offer significant reductions in carbon footprint and cost. Furthermore, seeing the patient in their own environment provides extra information on their social context and home situation.

The main strength of our study is that this is, to our knowledge, the first randomised controlled trial to investigate online video consultation for preoperative surgical consultation for major abdominal surgery including obtaining informed consent. Such high-demand consultations require extensive and precise information transfer and well adjusted emotional support. In addition, analysis of patient information recall in a randomised setting is another novelty of our study. Subgroup analyses for patients' age, health literacy, and digital health literacy revealed no additional differences, making the results easily extrapolatable.

However, this study also has several limitations. First, because being able and willing to participate in an online video consultation was a prerequisite for participation in this study, these findings apply only to such patients. This limitation is considerable, as 75 (29%) of 263 patients screened for the study either preferred face-to-face consultation or were unable to participate in online video consultation. Consequently, online video consultations cannot replace face-to-face consultations, but should be seen as an additional option alongside face-to-face and telephone consultations. Giving patients a voice in how they would like to receive care is an important element of health-care quality.[11] Second, results on technical adverse events for online video consultation were available only for the second half of all included patients, which could have resulted in a type II

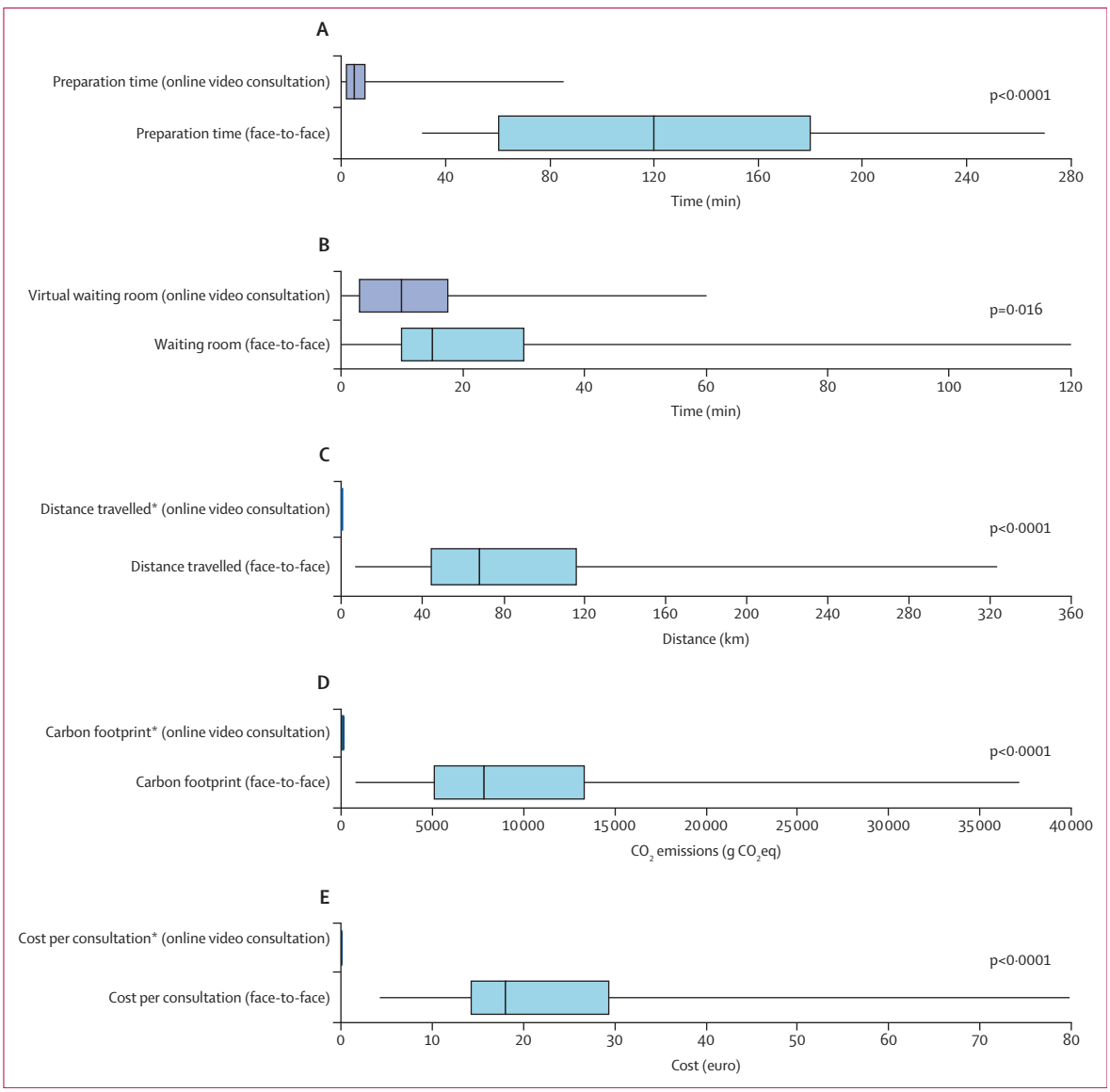

Figure 3: **Time, costs, and carbon footprints associated with online video consultation versus face-to-face consultations for major abdominal surgery**
The midline of the boxes represents the median, the box bounds indicate the IQR, and the lines indicate the minimum and maximum values. (A) Preparation time, comprising system start-up time for online video consultation and travel time (both to and from the hospital) for face-to-face consultation. (B) Time spent in the virtual waiting room (for online video consultation) and the hospital waiting room (for face-to-face consultation). (C) Distance travelled. (D) Carbon footprint. (E) Costs per consultation, comprising electricity costs for online video consultation and travel plus parking costs for face-to-face consultation. CO_2eq=equivalent CO_2 emissions. *Because estimates were the same for all patients receiving online video consultation, no ranges were associated with the estimate.

error. Moreover, as it is likely that patients who agreed to participate in the study were those who were already familiar with digital applications, digital health literacy might not have had a substantial role in this study. Third, although all patients were sent reminders and received a telephone call if they had not completed the questionnaires within 48 h after the consultation, 25% of information recall questionnaires and 15% of patient satisfaction questionnaires were filled in more than 7 days after the consultation, which might have negatively influenced the internal validity. However, in two post-hoc sensitivity analyses, excluding these late responses did not alter the main study findings. Fourth, our study included various medical subspecialties, encompassing more than ten different surgical procedures, rather than focusing solely on a specific procedure. However, these procedures are all major abdominal surgical procedures, and the inclusion of various subspecialties contributes to the external validity of the study. Also, after adjusting for this variable, the non-inferiority of online video consultation remained. Fifth, actual CO_2 emissions largely depend on factors such as distance travelled (eg, increased centralisation of care or larger countries can result in longer travel

distances), local regulations (eg, which cars are permitted by national legislation), and patients' vehicle preference (ie, public transport; fossil fuel, electric, or hybrid car; or bike). Because we assumed that 100% of patients travelled by fossil fuel car, the carbon footprint of face-to-face consultation might have been overestimated. Sixth, no information on the patients' ethnicity was obtained. Although our study focused on aspects unrelated to ethnicity, this should be considered in future studies. Seventh, patients who require a physical examination might not be eligible for online video consultation. However, online video consultation does not necessarily need to be the first consultation between the patient and surgeon; it could be used for any consultation following physical examination. In fact, some patients in our study had already met their surgeon previously, for example at a multidisciplinary clinic before the final decision for surgery could be made. The disparity in terms of previous meetings could be seen as a limitation, but probably also reflects daily clinical practice in many hospitals.

The results of this study should also be seen in light of important developments in modern-day health care: centralisation of care, patient ageing, and climate change. The centralisation of major and complex surgery is encouraged by many—including several European governments and many hospitals—to improve patient outcomes and reduce postoperative mortality.[4,37,38] However, centralisation increases the travel burden for many patients[39,40] and particularly affects those who are socioeconomically disadvantaged, older, or minoritised, hindering their access to health care. Because health care should remain accessible to everyone, online video consultation might help to address these challenges. The climate crisis is urging the health-care sector to decarbonise, which is a challenging task as it could put patient safety and satisfaction at risk. However, as online video consultation shows non-inferiority in patient satisfaction, it could contribute to making health care more sustainable, especially considering the high number of consultations conducted in hospitals every day.

Given the feasibility for relatives to join the consultation, future studies could focus on integrating online video consultation into daily practice and, where relevant, obtaining adequate reimbursement from health insurance for online video consultation. For successful implementation of online video consultation, a functional support system for both patients and health-care providers is essential. Developing an implementation team can be crucial and very helpful in this context, either online or in the form of a helpdesk. For example, at Amsterdam UMC, an implementation team supports patients with eHealth questions and a digital helpdesk supports health-care providers.[1] In addition, at Amsterdam UMC, patients can now indicate their consultation preferences via MyChart, selecting from telephone, online video, or face-to-face consultation. Also, as patient consultation is increasingly conducted using shared decision-making principles, future prospective (and ideally randomised) studies should assess whether online video consultation is non-inferior to face-to-face consultations in this respect.[41]

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Contributors

BHEAtH and MGB supervised the study. BHEAtH, MGB, BVJ, EZB, OCD, MCdB, GK, and MPS contributed to the study design, coordination of the trial, and data collection. BHEAtH did the literature review and the data management. BHEAtH, MGB, and SvD contributed to the data analysis. BHEAtH, MGB, WJKH, and MPS contributed to the data interpretation. BHEAtH, MGB, WJKH, BVJ, EZB, MIvBH, SSG, WJE, JIE, MDPL, ORB, OCD, MCdB, GK, and MPS critically revised the content and approved the final manuscript. All authors had full access to the data in the study and had final responsibility for the decision to submit for publication.

Declaration of interests

We declare no competing interests.

Data sharing

The anonymised datasets used in this study can be made available upon reasonable request to the corresponding author.

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