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Telemedicine versus face-to-face follow up in general surgery: a randomized controlled trial

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Abstract

Background: Telemedicine provides healthcare to patients at a distance from their treating clinician. There is a lack of high-quality evidence to support the safety and acceptability of telemedicine for postoperative outpatient follow-up. This randomized controlled trial—conducted before the COVID-19 pandemic—aimed to assess patient satisfaction and safety (as determined by readmission, reoperation and complication rates) by telephone compared to face-to-face follow-up after uncomplicated general surgical procedures.

Methods: Patients following laparoscopic appendicectomy or cholecystectomy and laparoscopic or open umbilical or inguinal hernia repairs were randomized to a telephone or face-to-face outpatient clinic. Patient demographics, perioperative details and postoperative outcomes were compared. Patient satisfaction was assessed via a standardized Likert-style scale.

Results: One hundred and twenty-three patients were randomized over 12 months. Mean consultation times were significantly shorter for telemedicine than face-to-face clinics (telemedicine 10.52 ± 7.2 min, face-to-face 15.95 ± 9.96 min, $P = 0.0021$). There was no difference between groups in the attendance rates, nor the incidence or detection of postoperative complications. Of the 58 patients randomized to the telemedicine arm, 40% reported high, and 60% reported very high satisfaction with the method of clinic follow-up.

Conclusion: Telemedicine postoperative follow-up is safe and acceptable to patients and could be considered in patients undergoing uncomplicated benign general surgery.

Introduction

Routine postoperative follow-up of surgical patients was historically a face-to-face outpatient appointment. Telemedicine uses telecommunication technology to provide healthcare to patients regardless of their location from the treating clinician.[1] Telemedicine may benefit both patients and clinicians, with studies demonstrating reduced waiting times and travel burden, cost savings and improved access to specialist care.[2] During the coronavirus outbreak in the 2019 (COVID-19) pandemic, telemedicine rapidly became the method of outpatient follow-up across medical and surgical specialities.[3] This was implemented by necessity, despite a paucity of literature on the safety and efficacy of telemedicine in the postoperative setting. The existing literature has not established if telemedicine follow-up is acceptable to patients or allows adequate provision of post-operative care (including timely diagnosis and management of postoperative complications). This randomized control non-blinded trial—conducted before the COVID-19 pandemic—aimed to assess patient satisfaction and safety (as determined by rates of readmission, return to theatre, missed diagnosis and complications) by telephone compared to face-to-face clinic follow-up after uncomplicated general surgical procedures.

Methods

A single-centre randomized controlled trial was performed at a general surgical unit in a metropolitan tertiary hospital from February 2019 to March 2020. Consecutive patients who underwent elective or emergency laparoscopic appendicectomy, laparoscopic cholecystectomy, and laparoscopic or simple open umbilical or inguinal

hernia repair were recruited for the trial before discharge. All patients over the age of 18 years with access to a phone and able to communicate in English were considered eligible.

Under the supervision of senior surgical staff, patients were excluded if they lacked the capacity to consent, resided overseas, were incarcerated, or were without a fixed abode. Complicated surgical patients were excluded from this study. This was defined as patients with complex hernia repair (giant inguinoscrotal or recurrent herniae), patients with intraoperative surgical complications (e.g., perforated appendicitis with four-quadrant pus or procedures converted to open) and patients with any severe post-operative inpatient complication (defined as Clavien Dindo grade three or above).[4]

Patients were assigned a unique study number in the sequence and, with computerized block randomisation, were randomly allocated in a 1:1 ratio to telephone or face-to-face clinic follow-up at 3–4 weeks post-discharge date. Patients were reviewed by a non-blinded junior doctor, with supervision provided by a surgical registrar or consultant. As per standard clinic policy, patients who did not attend their scheduled appointments were re-called twice before being discharged from the clinic. All patients completed a standardized Likert scale patient satisfaction survey from Grey *et al.*[5] following the consultation (Supporting Information Table S1). All patients randomized to telemedicine were followed up with an additional phone call 3 months postoperatively for quality and safety to assess if complications had been missed.

Data points included patient demographics and perioperative details (including complications such as re-admission or return to theatre). Consultation time was recorded from the start to the completion of a phone call for telemedicine clinics and from when a patient entered until they left the consultation room (excluding waiting time) for face-to-face clinics. Details on patients' recovery at the follow-up appointment were recorded—including patient or clinician-reported tenderness at the incision site at the time of review; wound healing complications; fevers; patient-reported pain scores and use of analgesia; and if the patient had returned to work, exercise or activities of daily living (ADLs). All data were stored and managed in REDCap (Research Electronic Data Capture).[6]

A sample-size calculation was carried out based on published literature.[7] For a reported inferiority margin of 0.12, Fisher's Z test yielded a total sample size of 198 patients (99 in each arm) to reach an 80% and 0.05 statistical significance. This original target was not achieved due to COVID-19 pandemic and only 123 patients were recruited. The post-hoc analysis confirmed a power of 85.7% with this smaller sample size. A comprehensive review of the literature shows that previous studies on general surgeries[8,9] all had lower or comparable sample sizes. Furthermore, we have applied bootstrapping techniques to re-sample the existing datasets to further account for the potential impact of the early termination of recruitment (Supporting Information, Table S2).

Statistical analysis

Categorical variables were presented as frequencies and percentages. Continuous variables were presented as mean values, including patients' age and consultation times. A 5-point Likert Scale was used to record patient satisfaction, with one representing 'strongly agree' and five 'strongly disagree'. Responses were ordinal variables and presented as frequencies in bar charts. Chi-squared tests compared categorical variables. Student's t-tests compared continuous variables. Kruskal-Wallis tests compared differences in ordinal variables. Poisson's regression and the independent incidental risk ratio (IRR) of multiple factors were performed to explore how factors impacted patients' satisfaction. Statistical significance was accepted with P-values <0.05. All statistical analysis was performed using Stata 17.[10]

Ethics

This study received approval from the institution's ethics review board (LNR/18/SVHM/290). This randomized control trial was registered in the Australian New Zealand Clinical Trials Registry (ACTRN12619001574134). All research procedures were conducted by both the Declaration of Helsinki and guidelines from the National Health and Medical Research Council.[11] Informed written consent was obtained from each participant before enrolment in the study.

Results

Demographics

Three hundred and five patients were assessed for the study. One hundred and twenty-three met inclusion and exclusion criteria, provided written informed consent and were randomized (Fig. 1). There were no differences in the baseline demographics and operative interventions between the two groups (Table 1). When patients did not consent, they were followed up in face-to-face, rural general practice or private specialist clinics and did not have any postoperative complications.

Outcomes

There was no significant difference in patient or clinician-reported incision site tenderness ($P = 0.421$), use of simple and/or opiate analgesia ($P = 0.625$), or patient or clinician-reported wound healing concerns at consultation ($P = 0.066$). The rate of patients returning to normal activities at a consultation between the groups was not different: return to work ($P = 0.153$), exercise ($P = 0.829$) and activities of daily living ($P = 0.357$). Seven telemedicine patients and three face-to-face follow-up patients had postoperative wound infections and/or delayed wound healing managed with oral antibiotics by a general practitioner ($P = 0.507$). There were no mortalities or unplanned returns to theatre in this study. One patient randomized to the telemedicine clinic represented to the emergency department on day two postoperatively and was readmitted with a pulmonary embolism (Table 2).

Consultation time

Telemedicine clinic consultation time was significantly shorter than face-to-face clinic consultation time (telemedicine mean

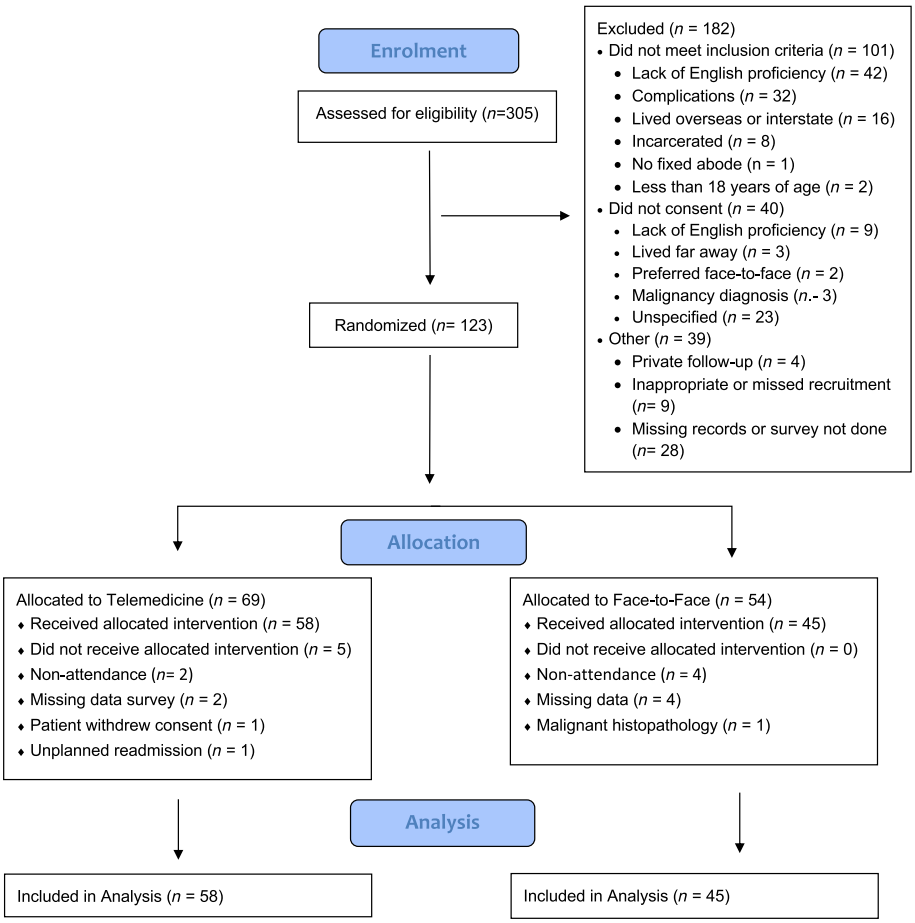

Fig. 1. CONSORT flow diagram of participant recruitment and progress in this randomized control trial.

Table 1 Patient demographics, surgical procedures and complications of patients followed up in telemedicine and face-to-face clinics

		Telemedicine ($n = 58$)	Face-to-face ($N = 45$)	Total cohort ($n = 103$)	*P*-value*
Gender	Male	26 (45%)	19 (42%)	45 (44%)	1.000
	Female	32 (55%)	26 (58%)	58 (56%)	
Age at Operation	Mean	46.59	47.22	46.87	0.8329
	STD	15.18	14.49	14.81	
	Range	[22.5, 77.4]	[24.2, 79.5]	[22.5, 79.5]	
Surgery	Laparoscopic appendicectomy	11 (19%)	10 (22%)	21 (20%)	0.399
	Laparoscopic cholecystectomy	34 (59%)	31 (69%)	65 (63%)	
	Open inguinal hernia repair	0	0	0	
	Open umbilical hernia repair	7 (12%)	2 (4%)	9 (9%)	
	Laparoscopic inguinal hernia repair	4 (7%)	2 (4%)	6 (6%)	
	Laparoscopic umbilical hernia repair	2 (3%)	0	2 (2%)	

*Significance ($P < 0.05$) was calculated by *t*-test for continuous data variables and chi-square test for categorical variables.

10.52 ± 7.12 min, face-to-face mean 15.95 ± ± 9.96 min, $P = 0.0021$) (Table 2).

Acceptability

Six patients did not attend clinic follow-up, with no significant difference between the groups (telemedicine 3%, in-person 8%, $P = 0.408$). The majority of patients in both clinics strongly agreed they were happy with the outcome of surgery (telemedicine 67%, in-person 61%, $P = 0.536$), their allocated clinic method (telemedicine 53%, in-person 56%, $P = 0.845$), the timing of review (telemedicine 52%, in-person 49%, $P = 0.692$) and the overall experience (telemedicine 60%, in-person 49%, $P = 0.318$) (Fig. 2). Approximately one-third of patients in both clinics would have preferred a different follow-up method (telemedicine 36%, in-person 31%). Five patients allocated to telemedicine clinic presented to the face-to-face clinic on their appointment and were excluded from the final analysis as surveys were not completed. When analysing patients' preference for an alternative clinic method, telemedicine clinic patients' mean score showed a skew toward five ('strongly disagree') compared to patients in face-to-face clinics (one-sided $P = 0.0268$). We did not find any other single- or double-sided

Table 2 Clinic consultation times (minutes) and postoperative outcomes in telemedicine and face-to-face clinics

	Telehealth ($n = 58$)	Face-to-face ($n = 45$)	Total cohort ($n = 103$)	*P*-value*
Consultation time (min) *mean/median (sd) [min, max]*	10.52/10 (7.12) [3, 45]	15.95/12 (9.96) [4, 49]	12.88/10 (8.85)	0.0021/0.0007
Fever or sweats (%)				0.228
Yes	5 (8.62)	1 (2.22)	6 (5.83)	
No	53 (91.38)	44 (97.78)	97 (94.17)	
Pain score (%)				0.189
0	22 (37.93)	24 (53.33)	46 (44.66)	
1	5 (8.62)	1 (2.22)	6 (5.83)	
2	1 (1.72)	2 (4.44)	3 (2.91)	
3	0	0 (0)	0 (0)	
4	0	1 (2.22)	1 (0.97)	
5	30 (51.72)	17 (37.78)	47 (45.63)	
Taking analgesia				0.625
Yes	13 (23.21)	8 (18.18)	21 (21)	
No	43 (76.79)	36 (81.82)	79 (79)	
Tenderness (%)				0.421
Yes	28 (48.28)	17 (38.64)	45 (44.12)	
No	30 (51.72)	27 (61.36)	57 (55.88)	
Wound healing concerns (%)				0.066
Yes	14 (24.14)	4 (8.89)	18 (17.48)	
No	44 (75.86)	41 (91.11)	85 (82.52)	
Return to exercise (%)				0.829
Yes	38 (67.86)	32 (71.11)	70 (69.31)	
No	18 (32.14)	13 (28.89)	31 (30.69)	
Return to ADLs (%)				0.357
Yes	53 (91.38)	38 (84.44)	91 (88.35)	
No	5 (8.62)	7 (15.56)	12 (11.65)	
Return to work (%)				0.153
Yes	35 (77.78)	36 (90.00)	71 (83.53)	
No	10 (22.22)	4 (10.00)	14 (16.47)	
Discharged from clinic (%)				0.864
Yes	55 (94.8)	43 (95.6)	98 (95.1)	
No	3 (5.2)	2 (4.4)	5 (4.9)	

Note: Pain score rating 0 (no pain) to 5 (severe pain); activities of daily living (ADLs).

*Significance ($P < 0.05$) was calculated by t-test for continuous data variables and chi-square test for categorical variables.

statistical difference between the two groups and the other patient survey responses.

Influencing factors

A patient's requirement to attend further appointments or not having returned to ADLs at the follow-up time was associated with lower patient satisfaction ($P = 0.002$; $P = 0.015$). In contrast, patients attending face-to-face clinics tended to prefer telemedicine clinics, regardless of whether they returned to ADLs or needed further appointments ($P = 0.048$; $P = 0.039$) (Table 3).

Discussion

A pilot study by Hwa *et al.*[12] in 2013 found that a phone call following benign uncomplicated general surgical procedures could be a safe and effective alternative to face-to-face clinic follow-up postoperatively. Our randomized trial sought to expand on this pilot study and has provided additional evidence regarding the safety (as determined by rates of readmission, return to theatre and complications) and patient satisfaction of telemedicine in the postoperative setting.

In response to the COVID-19 pandemic, telemedicine rapidly accelerated for outpatient clinics across medical and surgical specialities to reduce the number of face-to-face clinical interactions between patients and staff. In Australia, Medicare Benefits Schedule item numbers introduced to fund telemedicine revealed that 14% of specialist consultants were conducted via telemedicine, and 80% were over the telephone between March 2020 to September 2020.[3] After a systematic review of telehealth services, the Royal Australasian College of Surgeons advocated for ongoing access to telemedicine funding.[3] In that study, they found high patient satisfaction, time and cost savings, and comparable quality of access to healthcare through telemedicine. It has also been reported that clinicians have increased satisfaction with telemedicine. However, they noted that the evidence to support the safety and efficacy of telemedicine compared to face-to-face clinics is limited, particularly following surgery. The results of our study support the safety and utilization of telemedicine postoperatively in patients undergoing uncomplicated emergency general surgical procedures in Australia. There were no statistically significant differences in the diagnosis or rate of complications compared to face-to-face clinics. There were also no missed complications in the telehealth group which may have been a concern with a lack of physical examination and wound assessment via telehealth. This is consistent with other available published series.[2,12–15]

Telemedicine clinic consultation times were significantly shorter than face-to-face clinic consultation times, without any evidence to

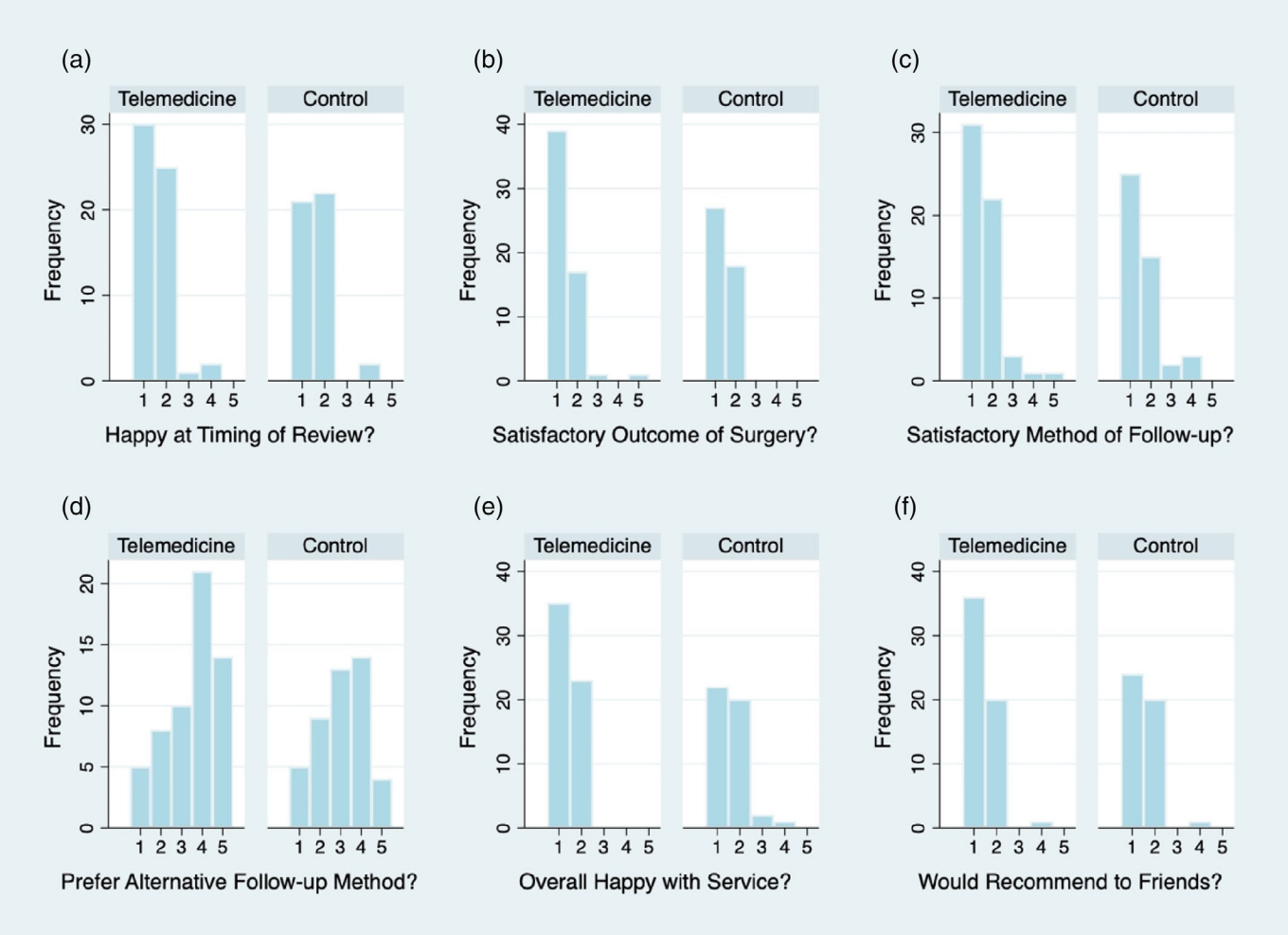

Fig. 2. Patient satisfaction survey responses (1 strongly agree to 5 strongly disagree) (*x*-axis) from telemedicine and face-to-face clinic groups, highlighting the frequency and distribution of scores in each question. Patient survey questions: (a)—You were happy with the timing of the post-operative review; (b)—The outcome of your surgery was satisfactory; (c)—Your method of postoperative follow-up was satisfactory; (d)—You would prefer an alternative way of follow-up; (e)—Overall you were happy with the service provided; (f)—You would recommend the service to a friend.

suggest a negative impact on patient care or a difference in patient satisfaction. The difference of approximately 5 min is likely multifactorial but would include reduced physical examination in telemedicine compared to face-to-face clinics. There was no difference in non-attendance rates between the two groups in our study, which contrasts with Ma *et al*., who demonstrated significantly higher non-attendance rates in face-to-face clinics than in telephone follow-up in their prospective study in an Australian population undergoing acute general surgical interventions.[8] Their study concluded that high attendance rates for telehealth follow-up were due to the increased accessibility, convenience and lack of travel time with telephone follow-up.[8]

Participants in our study reported high satisfaction rates with telemedicine follow-up compared to face-to-face. These results have been replicated in international randomized trials in American and Spanish general surgery populations.[8,12–14] Other randomized trials to assess postoperative telemedicine follow-up in urology, orthopaedics, and plastic surgery also corroborate that telemedicine is safe, associated with high patient satisfaction and significant economic savings for patients.[16,17] 36% of patients who had telemedicine follow-up preferred a different method of follow-up, with one patient commenting specifically that they would ultimately still prefer face-to-face clinic follow-up. Increased patient satisfaction is a key outcome measure when designing novel service provisions of healthcare, and the use of patient-reported outcome measurement tools has been repeatedly shown to improve patient safety.[18,19] Thus incorporating flexibility with telemedicine or face-to-face clinic follow-up may be required.

This telemedicine intervention was a simple phone call; thus, it can be easily and efficiently implemented at most institutions since sophisticated technology systems are not required. This study did not analyse economic differences between the two clinic modalities. Our finding of shorter consultation times in telemedicine and other studies demonstrating financial and time savings for clinicians and patients suggest telemedicine clinics have economic benefits.[8]

It is unknown if telemedicine is also suitable for patients following more complex surgical procedures or those with postoperative complications. The lack of blinding for clinicians in clinic was

Table 3 Poisson's regression of factors that may influence a patient's postoperative satisfaction independent clinic follow-up

	A	B	C	D	E	F
Age						
IRR of F2F	1.03, $P = 0.778$	0.99, $P = 0.94$	1.00, $P = 0.992$	0.88, $P = 0.071$	1.13, $P = 0.112$	1.07, $P = 0.436$
IRR of age	1.11, $P = 0.248$	1.00, $P = 0.36$	1.00, $P = 0.754$	1.00, $P = 0.064$	1.00, $P = 0.744$	1.00, $P = 0.580$
Gender						
IRR of F2F	1.02, $P = 0.816$	0.98, $P = 0.828$	1.00, $P = 0.991$	0.87, $P = 0.058$	1.14, $P = 0.097$	1.06, $P = 0.468$
IRR of female *vs.* male	1.00, $P = 0.931$	1.08, $P = 0.371$	1.22, $P = 0.037$	0.90, $P = 0.145$	1.15, $P = 0.074$	1.05, $P = 0.560$
Type of operation						
IRR of F2F	1.04, $P = 0.697$	0.99, $P = 0.951$	1.01, $P = 0.959$	0.88, $P = 0.074$	1.15, $P = 0.078$	1.07, $P = 0.448$
Laparoscopic Appendicectomy	1	1	1	1	1	1
Laparoscopic Cholecystectomy	1.06 $P = 0.572$	1.10, $P = 0.325$	1.03, $P = 0.799$	0.95, $P = 0.493$	1.10, $P = 0.328$	1.09, $P = 0.408$
Open Inguinal	NA	NA	NA	NA	NA	NA
Open Umbilical	0.88, $P = 0.404$	0.95, $P = 0.704$	0.85, $P = 0.266$	1.05, $P = 0.636$	1.00, $P = 0.998$	0.98, $P = 0.896$
Laparoscopic Inguinal	1.21, $P = 0.108$	1.55, $p < 0.000$	1.38, $P = 0.037$	1.61, $P = 0.131$	1.23, $P = 0.123$	1.10, $P = 0.559$
Laparoscopic Umbilical	1.33, $P = 0.004$	0.78, $P = 0.003$	0.96, $P = 0.864$	0.98, $P = 0.937$	1.16, $P = 0.553$	0.75, $P = 0.001$
Return to ADLs						
IRR of F2F	1.02, $P = 0.846$	0.97, $P = 0.716$	0.98, $P = 0.812$	0.86, $P = 0.039$	1.11, $P = 0.127$	1.06, $P = 0.456$
IRR of no to yes	1.23, $P = 0.108$	1.52, $P = 0.012$	1.54, $P = 0.015$	1.11, $P = 0.335$	1.39, $P = 0.011$	1.23, $P = 0.137$
Further appointments required						
IRR of F2F	1.04, $P = 0.614$	1.02, $P = 0.752$	1.03, $P = 0.742$	0.87, $P = 0.048$	1.15, $P = 0.073$	1.08, $P = 0.366$
IRR of no to yes	0.72, $P = 0.055$	0.53, $P = 0.002$	0.54, $P = 0.002$	1.10, $P = 0.665$	0.87, $P = 0.213$	0.96, $P = 0.760$

Note: Patient survey questions: A—You were happy with the timing of the post-operative review; B—The outcome of your surgery was satisfactory; C—Your method of postoperative follow-up was satisfactory; D—You would prefer an alternative method of follow-up; E—Overall you were happy with the service provided; F—You would recommend the service to a friend. Incident risk ratio (IRR); activities of daily living (ADLs); face-to-face clinic (F2F).

unavoidable due to the nature of follow-up and may lead to participant response bias and influence treatment effect. Over half the patients recruited were excluded for reasons that reflect any telemedicine follow-up programme's barriers and limitations. The safety and efficacy of telemedicine follow-up for patients without reliable access to technology or patients from non-English speaking backgrounds is not answered by this study. These groups are over-represented by socially disadvantaged groups who may be most impacted by telemedicine's benefits. Future studies should address how to facilitate telemedicine clinics for patients without reliable access to housing or technology.

This is the first randomized controlled trial of telemedicine follow-up for a general surgical population in an Australian population. The study was conducted before the widespread adoption of telemedicine in the COVID-19 pandemic and ended early due to the mandated change to telehealth. It has the advantage of directly comparing face-to-face and telemedicine follow-up, finding telemedicine to safe and effective. While the subsequent adoption of telemedicine was born of necessity in the COVID-19 pandemic, our study demonstrates its advantages.

Conclusion

For patients undergoing benign uncomplicated general surgical procedures, telemedicine is a safe and effective method for postoperative follow-up. Telemedicine use is associated with high levels of clinician and patient satisfaction, with substantial time savings.

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Author contributions

Teagan Fink: Formal analysis; investigation; resources; validation; visualization; writing – original draft; writing – review and editing. **Qianyu Chen:** Formal analysis; software; validation; visualization; writing – original draft; writing – review and editing. **Lynn Chong:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; supervision; writing – review and editing. **Michael W. Hii:** Conceptualization; funding acquisition; investigation; methodology; project administration; resources; supervision; visualization; writing – review and editing. **Brett Knowles:** Conceptualization; funding acquisition; investigation; methodology; project administration; resources; supervision; visualization; writing – review and editing.

Conflict of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix S1 Document S1: Supporting information outlined the standardized patient questionnaire
Table S1: Outcomes of the standardized patient questionnaire
Table S2: Outcomes of the standardized patient questionnaire with bootstrapping