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Evaluating Safety of Telehealth for Initial Surgical Evaluation of General Thoracic Patients

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ABSTRACT

BACKGROUND The use of telehealth has grown exponentially since the COVID-19 pandemic. The safety of an initial telehealth preoperative evaluation for patients undergoing general thoracic procedures is unknown.

METHODS We retrospectively reviewed all patients who underwent a general thoracic surgical procedure at our academic tertiary care institution from January 2021 to December 2022. We determined that visits were performed through telehealth or an in-person visit and linked to our institutional Society of Thoracic Surgeons database to abstract outcomes. Our outcomes of interest included complications, readmissions, intraoperative conversions, and intensive care unit admissions. Hierarchical multivariate logistic regression was used and clustered within procedure type.

RESULTS Of 1348 patients who underwent a procedure in our institution, 469 (34.8%) patients had an initial telehealth preoperative evaluation. We analyzed outcomes for 757 patients who underwent a major thoracic procedure. Patients who had an in-person visit tended to be older with worse functional status. After multivariable adjustment, an initial telehealth evaluation was associated with a lower adjusted complication rate (31.6% vs 40.4%; odds ratio, 0.63 [95% CI, 0.46-0.88]; $P = .006$), with no significant difference in readmissions, intensive care unit admissions, or intraoperative conversions.

CONCLUSIONS This preliminary study of the use of telehealth for preoperative evaluation of patients undergoing general thoracic procedures suggests that it is a safe and feasible alternative to an in-person evaluation. Care must be taken to ensure that this pandemic-induced trend continues to improve patient access to surgical care without worsening or creating new disparities.

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Telemedicine plays an increasingly prominent role in contemporary health care delivery. Early experiences with telehealth for surgical care were limited to postoperative visits and wound assessments.[1] Analysis of these programs demonstrated improved health care access, excellent clinical outcomes and patient satisfaction, and savings to the health care system.[2] Some of the barriers that limited further adoption of telehealth included unfamiliarity with technology, costs of implementation, lack of

IN SHORT

- The results of this study suggest that telehealth preoperative evaluation is a safe and feasible alternative to an in-person evaluation.
- Further research is necessary to determine whether there are specific populations of patients for which telehealth preoperative evaluations are appropriate.
- Care must be taken so this technology does not worsen existing disparities or create new ones.

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reimbursement, patient or provider concerns, and worries about inferior health care delivery.[3] However, the public health measures triggered by the COVID-19 pandemic dramatically accelerated the adoption of telemedicine and expanded the indications within surgery to include preoperative evaluations.[4,5]

Whereas the pandemic motivated the uptake of telehealth preoperative evaluations within our department of general thoracic surgery, there are limited data on whether postoperative outcomes for patients who underwent initial telehealth preoperative evaluations are similar to those for patients who had an in-person evaluation. It is unknown whether the lack of in-person comprehensive physical examination or technologic limitations with the current state of telehealth may be inhibiting surgical decision-making.[6] This is particularly relevant given the diversity of disease treated within a general thoracic practice. It is also possible that telemedicine use may not be equivalent by all populations, resulting in new disparities or worsening of existing ones.[7,8] Prior studies of the safety of telehealth preoperative evaluations on surgical outcomes within other domains demonstrated equivalency but analyzed lower risk operations.[9,10]

With this context, we set out to perform a comprehensive evaluation of the use and postoperative outcomes of telemedicine preoperative evaluations for patients who underwent a general thoracic operation at our large academic tertiary care center. Our institutional protocol is such that all patients are offered a telehealth preoperative evaluation, and patients opt in or opt out on the basis of their personal preferences. The results of this study are critical to understand at this very moment as our field looks beyond the pandemic-induced trends to further optimize the use of telehealth within contemporary surgical care delivery.

PATIENTS AND METHODS

DATA SOURCES AND STUDY SAMPLE. We retrospectively reviewed charts of all patients who underwent a general thoracic procedure scheduled from the outpatient setting at the University of Michigan from January 1, 2021, to December 31, 2022. Demographic characteristics of the patients were obtained and linked to our institutional Society of Thoracic Surgeons (STS) database to abstract postoperative outcomes. All records were submitted using the major procedure data collection form version 2.41 from January 1, 2021, to June 30, 2021, and version 2.51 from July 1, 2021, to December 31, 2022. All operations were performed by a general thoracic surgeon at our institution. We then determined whether the initial preoperative evaluation was performed at an in-person visit or through telehealth (audio or video). We also calculated whether there were any additional visits before the procedure and the overall wait time to undergo the procedure.

OUTCOME DEFINITIONS. Our primary outcome was overall rates of postoperative complications, which were coded in the STS clinical registry. Rates of intraoperative conversions, unexpected intensive care unit admission, and 30-day readmissions were also abstracted from the STS database.

STATISTICAL ANALYSIS. Demographic data are presented in raw numbers and percentages. Univariate statistical tests were performed as appropriate. We performed hierarchical multivariable logistic regression for our outcomes of interest. We included age, sex, race, insurance type, American Society of Anesthesiologists class, functional status based on Eastern Cooperative Oncology Group score, surgeon, and procedure in our model. The standard errors were clustered by procedure category (foregut, thymic, esophageal, pulmonary). We excluded lung transplants from our multivariate analysis as our protocol was such that all pulmonary transplant evaluations began with an initial in-person evaluation.

SENSITIVITY ANALYSIS. As some patients had multiple visits before their operation, we stratified patients into 3 groups for our sensitivity analysis. These included patients who had only telehealth visits preoperatively, patients who had a mix of both in-person and telehealth visits, and patients who had only in-person visits. There were no intensive care unit admissions for patients who underwent only telehealth evaluations.

All statistical analyses were performed with Stata version 18 software (StataCorp LLC). All hypotheses were tested by a 2-sided approach, with $P < .05$ considered to be statistically significant.

RESULTS

STUDY COHORT. A total of 1348 patients underwent a general thoracic procedure by 1 of 7 surgeons at our institution in 2021-2022 that was preceded by an outpatient preoperative evaluation. There were 694 (51.5%) male patients with a mean (SD) age of 61 (14) years; 469 (34.8%) patients had an initial telehealth preoperative evaluation, and 521 patients (38.6%) had only a single evaluation before their operative date. Of those patients, 156 (29.9%) had only a single telehealth evaluation before their operative date. For patients with an initial telehealth visit, the median (interquartile range) time from initial evaluation to the date of the procedure was 53 (29-102) days compared with 61 (27-166) days for patients with an initial in-person visit ($P < .001$).

BIVARIATE ANALYSIS. Of the 1348 patients who underwent a general thoracic procedure, 757 patients underwent a major thoracic procedure coded for within our STS database (Supplemental Figure). Patients who underwent an initial telehealth preoperative evaluation were more likely to be younger with better functional status and to

TABLE 1 Patient and Procedural Characteristics Stratified by Type of Initial Preoperative Evaluation

Variable	In-Person Visit (n = 513)	Telehealth (n = 244)	*P* Value
Age, y	64.8 (11.8)	60.9 (12.5)	<.001
Male	232 (45.2)	109 (44.7)	
Race			
White	462 (90.1)	228 (93.4)	
Black	28 (5.5)	7 (2.9)	
Asian	11 (2.1)	4 (1.6)	
Other	12 (2.3)	5 (2.0)	
Smoking history			
Current smoker	45 (8.8)	23 (9.4)	
Never smoker	61 (11.9)	25 (10.2)	
Former smoker	253 (49.3)	123 (50.4)	
Governmental insurance	371 (72.3)	136 (55.7)	<.001
ASA class			<.001
II	79 (15.4)	51 (20.9)	
III	362 (70.6)	173 (70.9)	
IV	59 (11.5)	1 (0.4)	
ECOG 1+	218 (44.6)	81 (36.8)	.053
Hypertension	265 (53.0)	100 (44.2)	.029
Diabetes	77 (15.4)	36 (15.9)	
Coronary artery disease	83 (16.6)	27 (11.9)	
Congestive heart failure	27 (5.4)	11 (4.9)	
Atrial fibrillation	31 (6.2)	11 (4.9)	
Liver disease	17 (3.4)	4 (1.8)	
Vascular disease	16 (3.7)	15 (7.2)	.055
Stroke	112 (21.8)	48 (19.7)	
Cancer	94 (24.7)	52 (32.9)	.052
Major psychiatric disorder	143 (27.9)	89 (36.5)	<.001
FEV_1, %	83.2 (27.9)	92.0 (20.3)	.003
D_{LCO}, %	75.2 (26.1)	77.2 (20.1)	
Reoperative	65 (12.7)	31 (12.7)	
Preoperative chemotherapy	70 (13.6)	42 (17.2)	
Preoperative radiation therapy	67 (13.1)	37 (15.2)	
Procedure category			<.001
Transplant	51 (9.9)	0 (0.0)	
Lung	198 (38.6)	88 (36.1)	
Esophagus	91 (17.7)	54 (22.1)	
Thymus	27 (5.3)	20 (8.2)	
Foregut	146 (28.5)	82 (33.6)	
Robot assistance	202 (39.4)	115 (47.1)	<.001

Categorical variables are presented as number (percentage). Continuous variables are presented as mean (SD). ASA, American Society of Anesthesiologists; D_{LCO}, diffusing capacity of the lung for carbon monoxide; ECOG, Eastern Cooperative Oncology Group; FEV_1, forced expiratory volume in 1 second.

have private insurance, and they were less likely to have American Society of Anesthesiologists class IV comorbidity. These patients were also more likely to present in consultation for esophageal and foregut disease and were more likely to have a robot-assisted procedure (Table 1). These patients had an average of 2.0 (SD 1.0) total visits before the procedure compared with 2.6 (SD 2.9) total visits before the procedure ($P < .001$) for those with an in-person visit. Of 244 initial telehealth preoperative evaluations, 157 (64%) had a follow-up in-person visit, 19 (8%) had a follow-up telehealth visit, and 68 (28%) did not have any follow-up visits.

POSTOPERATIVE OUTCOMES. After multivariable adjustment, patients who had a telehealth evaluation had lower adjusted rates of complications (40.4% vs 31.6%; odds ratio, 0.63 [95% CI, 0.46-0.88]; $P = .006$). There was no significant difference in the other outcomes between the 2 groups (Table 2).

SENSITIVITY ANALYSIS. Of patients who underwent a major thoracic procedure, 462 (61.0%) had only in-person evaluations before their operative date, whereas 87 patients (11.5%) had only telehealth evaluations. Patients who had only telehealth evaluations were more

TABLE 2 Adjusted Postoperative Outcomes for Patients Stratified by the Initial Preoperative Evaluation

Outcomes	Odds Ratio (95% CI) (reference vs in-person)	Adjusted[a] Rates (95% CI)	
		In-Person Visit	Telehealth
All complications	0.63 (0.46-0.88), $P = .006$	40.4% (38.5-42.3)	31.6% (27.6-35.6)
Readmissions	1.13 (0.56-2.28)	8.4% (6.6-10.3)	9.3% (5.7-13.0)
Intraoperative conversions	1.16 (0.47-2.88)	8.3% (6.3-10.5)	9.5% (4.6-14.4)
Intensive care unit admission	0.52 (0.28-1.69)	5.3% (4.0-6.5)	2.9% (0.6-5.2)

[a]Adjusted for age, sex, race, insurance type, American Society of Anesthesiologists class, functional status, surgeon, and procedure, clustered by procedure.

likely to be younger and to have a higher functional status, and they had higher pulmonary function test results. They were more likely to present for evaluation of foregut or diaphragm disease and to undergo a robotic procedure (Supplemental Table).

After multivariable adjustment, patients who had a combination of telehealth and in-person evaluations had lower adjusted rates of complications (32.0% vs 39.9% in-person only vs 39.6% telehealth only; odds ratio, 0.66 [95% CI, 0.52-0.83] vs in-person only; $P < .001$). There was no significant difference in overall complication rate between patients who had only in-person or telehealth visits. There was no significant difference in the rest of the outcomes between the 3 groups (Table 3).

COMMENT

Our retrospective evaluation of the real-world use of telehealth preoperative evaluations for a general thoracic practice at a large academic medical center had 3 important findings. Patients who underwent an initial telehealth preoperative evaluation tended to be younger with better functional status and were more likely to have private insurance and lower comorbidity burden. Second, we found that postoperative outcomes for patients who underwent an initial telehealth preoperative evaluation were not worse than those for patients who had an in-person evaluation. Third, the results of our sensitivity analysis suggest that patients who underwent a combination of telehealth and in-person evaluations had the lowest rates of complications. This preliminary evaluation suggests that the use of telehealth preoperative evaluations for a general thoracic practice at a large academic medical center is safe and feasible.

Our overall rate of use of initial telehealth preoperative evaluations was lower than the 56% seen in breast surgery[9] but higher than the 14% to 18% reported in other studies.[6,10] We also found similar trends in demographics with regard to patients who prefer to use telehealth. Specifically, these patients were younger, had less severe comorbidity burden, and were more likely to have private insurance. Rates of individual comorbidities, preoperative chemotherapy or radiation therapy, and reoperative surgery were otherwise relatively similar between these 2 groups. As patients were always given the option for a telehealth visit in our institution, we hypothesize that these trends reflect differences in patients' access to and comfort with the technology necessary to complete a telehealth evaluation.

We found that patients who had an initial telehealth postoperative evaluation had significantly lower rates of postoperative complications but did not demonstrate any significant difference in the other outcomes of interest. It is unlikely that an initial telehealth preoperative evaluation is superior to an in-person visit, leading to improved outcomes. We surmise that these results are due to selection bias. Patients who elect to have an initial telehealth preoperative evaluation are likely to be more technologically savvy, more likely to be health literate, and more likely to have access to additional resources. Prior studies have demonstrated that these play a role in disparities in outcomes between patients who use telehealth and those who do not within other

TABLE 3 Adjusted Postoperative Outcomes for Patients Stratified by Proportion of In-Person and Telehealth Preoperative Visits

Outcomes	Odds Ratio (95% CI) (reference vs in-person only)		Adjusted[a] Rates (95% CI)		
	In-Person Only	In-Person + Telehealth	Telehealth Only	In-Person Only	In-Person + Telehealth	Telehealth Only
Complications	Reference	0.66 (0.52-0.83), $P < .001$	0.99 (0.86-1.13)	39.9% (38.4-41.3)	32.0% (29.3-34.7)	39.6% (38.0-41.3)
Readmissions	Reference	1.11 (0.73-1.68)	0.92 (0.30-2.82)	8.5% (6.8-10.3)	9.4% (7.9-10.8)	8.0% (1.8-14.2)
Intraoperative conversions	Reference	1.29 (0.95-1.75)	1.31 (0.15-11.3)	8.0% (6.3-9.8)	9.9% (9.2-10.7)	10.0% (0-5.9)

[a]Adjusted for age, sex, race, insurance type, American Society of Anesthesiologists class, functional status, surgeon, and procedure, clustered by procedure.

domains of medicine.[7,8] Our sensitivity analysis further enriches this understanding as it is the combination of telehealth and in-person visits that resulted in the lowest adjusted rates of postoperative complications compared with in-person only vs telehealth only visits. It is possible that these 2 mediums synergistically allow lowering of barriers to interacting with our system while maintaining a productive surgeon-patient relationship.

The results of this study should be considered with several limitations. First, this is a retrospective study from a single tertiary care institution, which may limit its generalizability. As we analyzed only patients who underwent a surgical procedure, we are unable to comment on whether patients who underwent an initial telehealth evaluation were appropriately managed nonoperatively. We also did not stratify preoperative telehealth evaluations by whether they took place over the phone or by video.

The Supplemental Material can be viewed in the online version of this article [https://doi.org/10.1016/j.atssr.2024.01.005] on http://www.annalsthoracicsurgery.org.

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