



# Lessons learned by thoracic surgeons during the COVID-19 pandemic

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**Background:** The scale of the coronavirus disease 2019 (COVID-19) pandemic has necessitated healthcare systems to adapt and evolve, altering physician roles and expectations. Thoracic surgeons have seen practice changes from new COVID-19 consults to necessary delay and triage of elective care. The goal of this study was to understand the impact of COVID-19 on thoracic surgeon experiences in order to anticipate roles and changes in practice in future such circumstances.

**Methods:** Semi-structured, qualitative individual telephone interviews were conducted with thoracic surgeons. Interviews were structured to understand how surgeons were impacted by the COVID-19 pandemic and to record lessons learned. Interviews were conducted until thematic saturation was achieved. Data were analyzed using matrix analysis.

**Results:** Eleven board-certified general thoracic surgeons from nine institutions were interviewed. Thoracic surgeon roles in COVID-19 care included critical care delivery, performing tracheostomies and establishing related protocols, and interventions for long-term airway complications. Attention was called to the impact of the pandemic on thoracic cancer: patients avoided hospitals because of concern over COVID-19, delaying care.

**Conclusions:** Thoracic surgeons played a critical role in the COVID-19 pandemic response in both technical patient care and administrative capacities. Primary care responsibilities included the development, administration and delivery of tracheostomy protocols, and the care of down-stream airway complications. Thoracic surgeons were critical in triage decisions to minimize the impact of COVID-19 on thoracic cancer care. Lessons learned during the COVID-19 pandemic may provide insight into opportunities to promote collaboration in thoracic surgery and facilitate improved care delivery in future settings of resource limitation.

**Keywords:** Coronavirus disease 2019 (COVID-19); lessons learned; thoracic surgery COVID-19; pandemic; qualitative

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## Introduction

As of April 2022, the coronavirus disease 2019 (COVID-19) pandemic has reached 512 million cases and over 6 million deaths globally (1-4). The scale and extent of the pandemic has necessitated burdened health-care systems to adapt and evolve. Consequently, this has resulted in a practice shift with altered roles and expectations for many physicians.

There are many potential roles for thoracic surgeons during a respiratory-symptom predominant viral pandemic. Certain complications of COVID-19 may require thoracic surgical intervention, including pneumothorax, pneumatocele, empyema, hemothorax, and end stage lung disease (5-8). Given their clinical familiarity with the airway, thoracic surgeons may be called on to perform tracheostomies. Extensive critical care experience may lead to enhanced critical care roles. Clinical leadership roles that thoracic surgeons may be adept at include aid in development of clinical protocols, triaging patient care, and determining how to prioritize elective thoracic cases when a hospital is in crisis with limited resources (9-11). However, there is limited published information regarding the experiences of thoracic surgeons during the COVID-19 pandemic.

The goal of this study was to understand the impact of COVID-19 on the clinical practices of thoracic surgeons in order to anticipate roles and changes in practice in future such circumstances. Interview topics included: (I)

defining the role the surgeon had during the pandemic; (II) the surgeon's belief about this role; (III) description of the typical thoracic consults and long-term complications seen specific to COVID-19 patients; and (IV) lessons learned from experiences during the pandemic.

It is critical to learn from the past experiences of our thoracic surgery colleagues and sharing these experiences may provide valuable lessons to foster a collaborative approach to care delivery during a global pandemic or other periods of resource limitation. This reflection on the effects of thoracic surgeons' experiences and the lessons learned during this recent COVID-19 pandemic will support future adaptability and improvements in thoracic surgery practice if faced with a resurgence of COVID-19, or a different pandemic-level crisis. We present the following article in accordance with the COREQ reporting checklist (available at <https://jtd.amegroups.com/article/view/10.21037/jtd-22-920/rc>).

## Methods

This was a qualitative assessment of thoracic surgeons' experiences during the COVID-19 pandemic using individual interviews. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Colorado Multiple Institutional Review Board (COMIRB) (No. 21-3924) and informed consent was obtained from all the participants.

## Participants

The study included thoracic surgical providers who are a part of the Thoracic Surgery Outcomes Research Network (ThORN), a health services research collaborative composed of thirty-nine general thoracic surgical faculty and trainees from multiple institutions in the U.S. and Canada.

## Recruitment

A purposive sample of thoracic surgeons were recruited via an email that was sent to the entire membership of ThORN in August, 2021, asking for voluntary participation in a qualitative study assessing how the COVID-19 pandemic had affected thoracic surgical providers. One recruitment email was sent to ThORN members 5 months after the initial invitation to recruit additional participants. Those who chose to be in the study were sent a postcard consent

### Highlight box

#### Key findings

- Thoracic surgeons had many responsibilities during the COVID-19 pandemic. Primary care responsibilities included the development, administration and delivery of tracheostomy protocols, and the care of down-stream airway complications.
- Thoracic surgeons were also critical in triage decisions to minimize the impact of COVID-19 on thoracic cancer care.

#### What is known and what is new?

- Little is known about the qualitative experience of thoracic surgeons during the COVID-19 pandemic.
- This is the first qualitative study of how thoracic surgeons were affected by the pandemic.

#### What is the implication, and what should change now?

- Lessons learned during the COVID-19 pandemic may provide insight into opportunities to promote collaboration in thoracic surgery and facilitate improved care delivery in a future pandemic or resource limited setting.

form to review.

### *Study design*

The study team developed the interview guide to elicit thoughts and opinions about general thoracic surgeons' professional experience with the duration of the COVID-19 pandemic, emphasis was placed on experiences during the initial pandemic surge in the spring of 2020. Each volunteer participated in a single semi-structured interview lasting between 10–30 minutes to determine their experience and beliefs surrounding their clinical experience during the COVID-19 pandemic. Interviews were completed between September 2021 and February 2022. All interviews were conducted individually via Zoom and audio was recorded with participant permission for transcription. One member of the study team (EOM) transcribed verbatim the recorded audio for the interviews. Transcriptions were not returned to participants for comment. The Consolidated Criteria for Reporting Qualitative Research (COREQ) (12) guided the rigor of this study.

### *Study team*

The study team was made up of four of the authors: RAM, MD (male) is a thoracic surgeon and was the principal investigator; ALK, PhD (female) is a health services researcher and was the principal qualitative methodologist; HM, MD (female) is a general surgery resident; EM, GED (female) is a transcriptionist. All team members were trained in qualitative interviewing and analysis by ALK. The interviews were conducted by the first author (HM) who had no previous relationships with the interviewees. The first author utilized field notes throughout the interviews. The study aim was briefly explained prior to the interview, no biases of the interviewer were discussed as these were minimal with no prior relationship.

### *Statistical analysis*

Data analyses were conducted by a qualitative methodologist, ALK, and the first author trained in such analyses, HM. The study team performed an inductive and deductive team-based analytical approach, drawing primarily on matrix analysis (13), and the data was organized with Microsoft Excel version 16.59 (Microsoft Inc, Redmond, WA, USA). A matrix analysis is a tabular format that arranges data for easy viewing in one place, permits detailed

analysis, and sets the stage for later cross-case analysis (13). Matrix analyses provide a visual format for showing and telling simultaneously. Two members of the research team (HJD, ALK) first independently coded the initial interviews and then reviewed the documents together to reach a consensus, thus defining the initial codebook. During the coding process, the data were examined and organized into categories, domains, and themes. Emergent codes (those that are newly found in the subsequent interviews or further data collection from medical records) were added to the codebook until thematic saturation occurred, e.g., no new concepts were identified (14,15). All analyses and findings were integrated and documented with an audit trail (12).

## **Results**

### *Participants*

Of the 39 individuals invited to participate, 11 were recruited (28%) and completed an interview over a 6-month period. Invitees who did not respond to the email invitations were assumed to be uninterested in participation, no participants chose to leave the study. All participants were board-certified cardiothoracic surgeons participating in general thoracic surgery practices at University or University-affiliated practices. Participants were 64% male, came from nine different academic institutions in seven states across the U.S. (California, Colorado, Georgia, Missouri, New York, New Hampshire, Texas). Participants had a range of years in practice (median 7 years, range <1–13 years) (*Table 1*).

Themes that emerged focused on the individual's role during the pandemic, beliefs about that role, characteristics of consults in COVID-19 patients to thoracic surgery services, long-term thoracic complications in COVID-19 patients, and reflections and lessons learned during the pandemic.

### *Thoracic surgeon roles and beliefs*

The role of the thoracic surgeon during the pandemic was geographically dependent. Two surgeons came from areas with very high census of COVID-19 hospitalized patients where all elective operations were cancelled. One surgeon ran the entire COVID tracheostomy team and performed all of the tracheostomies. The other surgeon had an additional critical care background and was able to use this to direct a COVID intensive care unit (ICU).

In areas that were not hit as hard by the pandemic,

**Table 1** Participant information

Surgeon number	Years in practice—thoracic surgery	Gender
1	5	M
2	3	M
3	5	M
4	11	F
5	13	M
6	12	M
7	5	F
8	9	M
9	1	F
10	8	M
11	7	F

M, male; F, female.

contingency plans were made for thoracic surgeons but often not needed (*Table 2*). The most common plan was for thoracic surgeons to help in the ICU, felt to be appropriate given thoracic surgeon familiarity with the ICU setting. “*We had a strategic plan that if the intensive care unit was overrun or had a lot of people who were unable to work that we would go to the ICU, but that never actually happened*” (#3).

In areas where the operating rooms could still run at some level, a critical role played by thoracic surgeons was involvement of triage of elective thoracic surgical operations. One thoracic surgeon sat on a committee that reviewed each case, ensuring that it met the criteria. Thoracic surgeons also worked at a national level to publish criteria for case prioritization (16). “*The ThORN group worked with the American College of Surgeons and came to a consensus about the definition of essential surgery for thoracic oncologic surgery*” (#5).

**Table 2** Summary of thoracic surgeons roles and changes in patient population during COVID-19, and suggestions for future involvement of thoracic surgeons in pandemic medicine

Thoracic surgeons' roles during COVID-19 pandemic	Change in patients cared for by thoracic surgeons during COVID-19 pandemic	Future options for engagement of thoracic surgeons during a pandemic
Performance of tracheostomies	Increase in long-term airway complication consults	Inclusion in early determination of hospital tracheostomy protocol
Determination of hospital's tracheostomy protocol	Increase in tracheostomy consults	Performance of tracheostomies and/or consultation for difficult tracheostomies
Thoracic surgical consults on COVID-19 patients	COVID-19 consults were typical thoracic issues (e.g., pneumothoraxes, empyema, pneumatoceles)	Determination of thoracic surgical elective case priorities
Critical care physician in COVID-19 ICU (or back-up critical care if needed)	High number of non-operative consults in COVID-19 patients	Back-up critical care physicians
Director of COVID-19 ICU	Desire to avoid procedures as able given poor outcomes of operations in COVID-19 patients	Assistance with hospital-level planning and preparedness committees
Participation in hospital COVID-19 preparedness and planning committees	Decrease in new cancer referrals (due to patient avoidance of care)	
Publication of guidelines for prioritization of thoracic elective cases		
Participation in hospital committees determining priority of thoracic surgical cases		
Community outreach (e.g., vaccine education)		
Continued performance of elective thoracic operations		

COVID-19, coronavirus disease 2019; ICU, intensive care unit.

A major finding was the large role thoracic surgeons played in tracheostomies for COVID-19 patients. Thoracic surgeons not only performed a large portion of tracheostomies, but also were critical to formulating protocols guiding COVID-19 tracheostomy placement at the hospital level. *“Our group (thoracic surgeons) has been very active in the airway management committee for these patients. So, we’ve created a certain protocol as to who should get a tracheostomy and when they should get it, who should be the one doing it. There have been many meetings about that”* (#6).

If not performing the tracheostomy, thoracic surgeons were available to *“intervene and lend a hand if there’s been a problem with surgical airways”* (#8). Overall, the participants felt that tracheostomies should be performed by a surgeon, *“I think that people who know the proper technique for doing a tracheostomy should be the ones doing them because improper technique leads to a lot of downstream complications”* (#1). The tracheostomies required modified technique to reduce aerosolization, necessitating the operator to be skilled to facilitate rapid placement. *“They were technically challenging to do, and they needed to be fast. Our average time was about three minutes for a tracheostomy. You really needed a surgeon there in case something went wrong”* (#2).

### **Consults and complications in COVID-19 patients**

Consults for thoracic surgeons in COVID-19 patients, outside of tracheostomies, were not atypical from routine thoracic practice (Table 2). There were many consults for chest tubes, mediastinal pathology, pneumatoceles, and pneumomediastinum. Few were operative, *“there were almost no major complications that required a big operation”* (#2). Pneumatoceles identified on chest computer tomography (CT) were noted to involute without surgical intervention.

Long-term complications in COVID-19 patients seen by thoracic surgeons were revealed to center around complex airway issues. Several surgeons reported seeing tracheal complications such as stenoses, injuries, and tracheoesophageal fistulae. *“We are now seeing ... either tracheostomy related problems or patients who have been on a ventilator for a significant period of time, and then they have upper airway stenosis. Or patients who have tracheostomy related complications like bleeding or stoma issues which are different from what we have seen before”* (#6). The surgeons did not feel that the cause of the airway problems was clear, whether it was from factors related to COVID-19 or airway and operative techniques. It was also reported that operations done on patients who had recovered from COVID-19 were

more challenging: *“I would say that I’ve operated on a number of patients who had COVID previously and I just see more scar tissue, more adhesions...and making it more complicated to do minimally invasive procedures”* (#11).

### **Unintended consequences of COVID-19**

The unintended consequences of delaying elective care were noted by many surgeons. Anecdotally it was reported that perhaps patients were avoiding health care despite elective services having resumed when the COVID risk decreased, resulting in delayed diagnoses or care. Patients remained reluctant to present for screening and surveillance and this effect had only begun to dissipate recently (1.5 years after the start of the pandemic). *“So elective care really didn’t get delayed too much but there were a lot of patients that just stopped going to the doctor. So, we are seeing cancers now that are stage II when we could have caught them and treated them as a stage I... We’re seeing more complicated benign things like trapped lungs and empyemas that probably could have been easily treated with a chest tube a year ago”* (#2).

The lung transplant referral system was also impacted as *“pulmonary patients were reluctant to come to the pulmonologists”* (#6). In this way, there were unintended ramifications of the COVID-19 pandemic even on patients who never contracted COVID. These unintended effects were noted to be beneficial by one surgeon, who found that CT scans in COVID-19 patients had allowed early diagnosis of lung nodules or mediastinal masses, prompting early treatment.

### **Take-away lessons**

There were two main lessons learned by thoracic surgeons: (I) a comprehensive and multi-disciplinary approach to tracheostomy management is critical; and (II) a more facile approach in returning to performance of elective operations is needed to mitigate delays in essential care (Table 2). *“I think to have a more holistic approach towards surgical airway management. I think for thoracic surgeons this was a big take home message. It was very fragmented and not really organized in terms of how it was approached at our institution, really whatever needed to get done was done by a variety of services. Yeah, and that model disintegrated in the face of the pandemic”* (#6).

Minimizing the impact on elective patients could be by allowing *“patients that were already in the pipeline”* (e.g., those already seen in clinic with operations planned) to get their operations rather than delaying them, *“that’s something that*

*we've talked about that if this would ever happen again, we would not do" (#10). The difficulty of knowing how to approach elective operations should not be underestimated, however. It was "messy" to try to predict how badly hit a hospital would be by COVID-19 (#9). "It's always easy to second guess things retrospectively, but we just didn't know. The only reason why it sticks out is because we weren't hit as badly as we thought we were going to be hit, had we been hit, no one would question it. And so that's just an impossible task to try to go back and figure that out" (#4).*

## Discussion

This study was intended to understand how thoracic surgeons were impacted by the COVID-19 pandemic and to elucidate what lessons were learned. We found that the role of the thoracic surgeon varied significantly depending on geographic location, but that most commonly, thoracic surgeons had roles in assisting in the ICU given their familiarity with that setting. Thoracic surgeons were also typically heavily involved in the surgical airway placement of COVID-19 patients, and the formation of hospital level protocols to guide airway management. Thoracic surgeons also managed airway complications, a result of prolonged intubation or tracheostomy. Administratively, many surgeons noted the importance of their participation in institutional decisions related to the triage of elective thoracic operations. Surgeons identified two primary lessons from their experience with the pandemic response. First, an organized approach to surgical airway management was felt to be critical during this respiratory pandemic. Secondly, and that the need to delay elective care early in the pandemic could have long-lasting effects for how patients interact with the healthcare system.

The importance of a designated tracheostomy protocol was apparent in this study and supported in the literature. Having a multi-disciplinary team (e.g., surgeon, critical care physician, anesthesiologist) that is dedicated to tracheostomy is particularly helpful (17,18). Performance of the procedure by the most experienced personnel reduces the infectious risk through aerosolization (17), and as the results of this study indicate, a surgeon who is familiar with the airway is critical for troubleshooting. Another important take-away regarding airway management during the COVID-19 pandemic was the impact of long-term complications, such as stenosis, that have been seen by the thoracic surgeons. Several etiologies have been proposed to cause these airway complications in COVID-19 patients:

tracheal cuff over-inflation, large caliber endotracheal tubes, patient factors such as diabetes, proning maneuvers, high dose steroids, viral replication in respiratory mucosa, prothrombic state, and prolonged hypoxemia (19-23). These issues may manifest weeks after the COVID-19 infection, consequently some have suggested that all COVID-19 patients should follow with an airway specialist after discharge to facilitate early diagnosis and treatment (19,20). Further study of these airway complications may be of interest to help to inform airway strategies in future pandemics.

The potential impact of COVID-19 with delayed diagnosis and treatment, especially of cancer, was a concerning finding of this study. The desire to avoid aerosolizing procedures has been shown to impact elements of the lung cancer staging work-up, including pulmonary function tests, endobronchial ultrasound, and bronchoscopy (24). Naturally, COVID-19 poses a challenge to cancer screening programs as well as routine communication between patients and providers regarding new symptoms or concerns (25,26). An analysis of Medicare patients found a 56% decrease in lung cancer screening during the early pandemic (27), one large study similarly found that 44.6% of facilities reported delays in lung cancer screening (28), and two different surveys of thoracic surgeons found detrimental impacts to thoracic oncologic screening and care during the pandemic, similar to the findings in our study (29,30). The CHEST expert panel anticipated these issues with lung cancer screening during the pandemic, and has published guidelines (31). Maringe *et al.* (32) performed a population level analysis and estimated a 4.8–5.3% increase in lung cancer deaths due to effect of the pandemic on cancer care. Based on the desire to prevent delays in oncologic patient care where able, the ThORN group published guidelines regarding triage of elective operations (16) to help guide other thoracic surgeons and we recommend attention to this special patient population during any future pandemic. Multi-disciplinary action is likely needed to mitigate the harms of the COVID-19 pandemic on cancer care (33).

The potential limitations of this study include: (I) small sample size; (II) potential that similar opinions could be influenced by a shared affiliation with the ThORN group; (III) homogeneity of sample as academic surgeons without community surgeon perspective (IV) possible attribution bias, which is interpretation based on judgements and assumptions about behaviors; and (V) extreme variability of COVID-19 hospitalization rates and impact by

geographic region and institution that make participant interviews difficult to correlate with exact COVID-19 case rates given the qualitative nature of the study. Yet, as one of the data analysts was not a surgeon, objectivity was addressed. Although the sample size was small, we believe the geographical and institutional diversity of participant practice settings and generalizability to academic thoracic surgical practice is a strength.

## Conclusions

The COVID-19 pandemic has been an unprecedented challenge for modern healthcare, and understanding the experiences and strategies employed by thoracic surgeons facilitates collaboration, an opportunity to learn, and experience upon which to draw should we have a later pandemic. Key findings of this study include the importance of institutions creating a hospital-level tracheostomy protocol developed with multi-disciplinary, including thoracic surgeon, input. Also, that anticipation of long-term effects of pandemic policies on thoracic surgical patients (e.g., the tendency of patients to delay care, resulting in delayed diagnoses, especially of cancer) is critical, and efforts to mitigate this such as increased public health messaging by thoracic surgeons or targeted patient outreach and counseling by providers could assist with mitigation of patient harm. These lessons can help to inform the role of thoracic surgeons in a future pandemic response.

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