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A 20-Year Update on the Practice of Thoracic Surgery in Canada: A Survey of the Canadian Association of Thoracic Surgeons

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Background: This study provides an update to a landmark 2004 report describing demographics, training, and trends in adherence to thoracic surgery practice standards in Canada.
Methods: An updated questionnaire was administered to all members of the Canadian Association of Thoracic Surgeons via email (n=142, compared to n=68 in 2004). Our report incorporates internal data from Ontario Health and the Canadian Partnership Against Cancer.
Results: Forty-eight surgeons completed the survey (male, 70.8%; mean±standard deviation age, 50.3±9.3 years). This represents a 33.8% response rate, compared to 64.7% in 2004. Most surgeons (69%) served a patient population of over 1 million per center; 32%–34% reported an on-call ratio of 1:4–1:5 days, and the average weekly hours worked was 56.4±11.9. Greater access to dedicated geographic units per center (73% in 2021 vs. 53% in 2004) has improved thoracic-associated services and house staff, notably endoscopy units (100% vs. 91%), with 73% of respondents having access to both endobronchial and endoscopic ultrasound. Access to thoracic radiology has also improved, particularly regarding positron emission tomography scanners per center (76.9% vs. 13%). Annual case volumes for lung (255 vs. 128), esophageal (41 vs. 19), and mediastinal resections (30 vs. 13), along with hiatal hernia repair (45 vs. 20), have increased substantially despite reports of operating room availability and radiology as rate-limiting steps.
Conclusion: This survey characterizes compliance with current practice standards, addressing the needs of thoracic surgeons across Canada. Over 85% of respondents were aware of the 2004 compliance paper, and 35% had applied for resources and equipment in response.

Keywords: Thoracic surgery, Health services research, Health workforce, Health resources

Introduction

General thoracic surgery in Canada was formally established by Dr. F. Griffith Pearson in 1976 as a distinct specialty from cardiac surgery, and it has since evolved into its current form [1,2]. The quality and scope of practice for thoracic surgery in Canada are regulated by national bodies such as the Royal College of Physicians and Surgeons of Canada (RCPSC) and the Canadian Association of Thoracic Surgeons (CATS). These bodies receive guidance, endorsement, and collaboration from organizations including the Canadian Partnership Against Cancer (CPAC), the American College of Chest Physicians, the European & American Society of Thoracic Surgeons, the American College of Surgeons, the American Association for Thoracic Surgery, the National Comprehensive Cancer Network, the Canadian Cancer Society, and Lung Cancer Canada, among others. Provincial health ministries and regional

entities further monitor resource allocation and case volume. However, a review of the limited literature currently available suggests a discrepancy between the development of these standards and the adherence to these recommendations in practice. This discrepancy indicates a lack of information, insufficient reporting of compliance, or both. Guidelines for the development of or updates to practice standards in thoracic surgery are often focused on surgeon competency, practice setting, necessary resources (such as personnel, equipment, and associated services), and quality improvement programs. Standards for thoracic surgery were initially developed by Darling et al. [3] at consensus conferences and were later updated by Sundaresan et al. [4]. The most recent update for thoracic surgery cancer care was outlined in the 2019 Pan-Canadian Standards for Cancer Surgery by CPAC and endorsed by CATS [5]. These standards are organized into 25 points, grouped under 3 overarching themes: surgeon criteria, practice setting, and quality processes [5].

Expert consensus positions and papers can evolve and improve over time. However, the Canadian literature on adherence to current practice standards for thoracic surgery is limited. Without a comprehensive review of the resources available to thoracic surgeons, gaps exist in the efficacy of standards development. Thoracic-associated cancers (lung, bronchus, and esophagus) have a projected incidence of 32,500 cases by 2022. Of these, 23,100 cases are expected to result in mortality, accounting for over one-quarter of cancer-related deaths [6]. To improve access to high-quality surgical care, meet workforce needs, and alleviate the strain on health systems and physician burnout, more transparent reporting is required on adherence to standards by surgeons and institutions. This will inform provincial and national standards. In contrast to our American counterparts, who face a predicted 61% increase in case volumes by 2035 that is projected to lead to a shortage of cardiothoracic surgeons [7], Canadian program directors and thoracic surgery residents report concerns related to post-graduate employment opportunities, with the workforce needs currently being met until 2030 [8,9]. Recently, CPAC surveyed CATS and developed focus groups for the qualitative assessment of the perceived barriers, enablers, and opportunities for implementing their practice standards [10]. They report that additional support is needed in areas including quality assurance, regional planning, surgeon workload, and pathology turnaround times. While some researchers have investigated quality improvement programs [11,12], surgical education [8], and workforce needs [13-16], more evidence is needed on adherence to practice standards. This will help identify and provide detailed information on the efficacy of specific standards.

As case volumes rise and the population ages, the health system and related services in thoracic surgery are under increasing strain. Projections indicate that the Canadian national population will grow by 10 million between 2011 and 2030 [13]. This growth underscores the need for an update to the landmark 2004 survey on compliance to standards of thoracic surgery practice in Canada, aimed at reflecting the current reality [3]. Alongside this update, we detail job satisfaction and trends at both provincial and national levels, drawing on internal communication from Ontario Health and the Canadian Partnership Against Cancer. Our goal is to provide an overview of the resources currently available to thoracic surgeons and evaluate their alignment with practice standards across Canada, thereby assessing the changes that have occurred since 2004.

Methods

Ethics statement

The Ottawa Health Science Network-Research Ethics Board and the Ottawa Hospital Research Institute granted approval for the collection of anonymized survey data with participant consent. This study was conducted in adherence to the principles outlined in the Declaration of Helsinki.

Development of survey questionnaire

A 9-page, 30-item survey questionnaire (Supplementary Material 1) was developed and informed by the baseline survey paper that followed the 2001 CATS consensus conference [3]. This newly developed survey received approval from select members of the CATS, CPAC, and Ontario Health surgery representative members. The questionnaire was created using the web-based software SurveyMonkey, accessible at https://www.momentive.ai (Momentive Inc., San Mateo, CA, USA). The survey encompassed a variety of questions, ranging from demographics, education, and training to available resources and staff, job satisfaction, case volumes, and wait times. The types of questions included free-text fields, multiple-choice responses, a Likert-type scale (4-point scale), and a ranking scale (1–6 scale).

Participants, survey administration, and data management

This survey questionnaire was distributed to all active

members of CATS who were practicing within Canada. In September 2021, an email was dispatched to all 142 active members of CATS. A subsequent reminder email was issued in November 2021, and the survey was concluded before January 2022. Participants were not offered any monetary incentives or compensation for completing the survey. A participant agreement consent form was appended and collected prior to survey completion, detailing the privacy of the stored data and the plans for knowledge dissemination and publication of anonymized data. Data were securely stored on a password-protected server within the Division of Thoracic Surgery. The data underpinning this article will be made available upon reasonable request to the corresponding author.

Statistical analysis

All data were screened, and free-text responses were standardized across all questionnaire items. Both fully and partially completed surveys were incorporated into the data analysis, which was conducted based on the number of respondents for each question. Furthermore, data from the 2004 paper were reported alongside relevant questions for comparative purposes. The data analysis involved univariate descriptive statistics, including frequencies, means± standard deviations, minimum–maximum ranges, and interquartile ranges. This analysis was performed using either IBM SPSS ver. 28.0 (IBM Corp., Armonk, NY, USA) or RStudio ver. 2022.02.3.492 (PBC, Boston, MA, USA) statistical software.

Results

Participant demographics

Of the 142 CATS members invited to participate, 48 surgeons took the survey, yielding a response rate of 33.8%. This represents a relative decrease of 30.9% from the 2004 survey, which had a response rate of 64.7% (44 of 68 surgeons) [3]. Regarding respondent age, the median (interquartile range) was 49.5 (43–55.5) years, with 33.3% of participants falling within the 50- to 60-year age bracket (Table 1). Of the respondents, over 70% (34 surgeons) identified as male, while approximately 23% (11 surgeons) identified as female. Most participants, 93.7% (45 surgeons) and 91.6% (44 surgeons), had received RCPSC certifications in thoracic and general surgery in Canada, respectively. Most of the respondents (93.7%) practiced in a university-affiliated hospital, while only 3 reported practicing in community-based practices. Respondents represented 23 university-affiliated centers and 3 community centers. The provinces with the highest numbers of respondents were Ontario (45.8%), Quebec (16.7%), British Columbia (12.5%), and Alberta (10.4%).

Table 1. Demographic and geographic profile in 2021 (n=48 respondents)

Characteristic	Value
Age (yr)	50.3±9.5
Age distribution (yr)	
<40	6 (12.5)
40–50	24 (50)
50–60	16 (33.3)
>60	6 (12.5)
Gender identity	
Female	11 (22.9)
Male	34 (70.8)
Prefer not to respond	3 (6.2)
Type of RCPSC certification in Canada	
General surgery	44 (91.6)
Thoracic surgery	45 (93.7)
Cardiac surgery	2 (4.2)
In progress	0
None	1 (2.1)
Type of practice	
Community-based	3 (6.3)
University-affiliated	45 (93.7)
Province of practice	
Alberta	5 (10.4)
British Columbia	6 (12.5)
Manitoba	2 (4.2)
New Brunswick	1 (2.08)
Newfoundland	0
Nova Scotia	2 (4.2)
Ontario	22 (45.8)
Prince Edward Island	0
Quebec	8 (16.7)
Saskatchewan	2 (4.1)

Values are presented as mean±standard deviation for continuous variables or number (%) for categorical variables.
RCPSC, Royal College of Physicians and Surgeons of Canada.

Workforce composition and characteristics

Of the 48 respondents, 68.8% served more than 1 million patients, working an average of 56.4±11.9 hours per week (encompassing both part-time and full-time schedules) (Table 2). This contrasts with the patient numbers in 2004, which ranged from 100,000 to 4 million. Furthermore, the average number of full-time thoracic surgeons per center has increased since 2004. At that time, university-based

Table 2. Workplace and workforce responses

Characteristic	Year	
	2021	2004
No. of respondents	48	44
Population serviced		
<250,000	1 (2.1)	-
250,000–500,000	3 (6.3)	-
500,000–1,000,000	11 (22.9)	-
>1,000,000	33 (68.8)	-
Range of population serviced (million)	-	0.1–4
No. of thoracic surgeons per center	3.7 (2–9)	-
Part-time	1.5 (1–3)	-
Full-time	4.3 (1–9)	-
Full-time university-based thoracic surgeons per center	4.5 (2–9)	2.4 (2–5)
Full-time community-based thoracic surgeons per center	2.3 (1–3)	1 (1–2)
Average hours working per week (hr)	56.4±11.9	-
Thoracic surgery on-call frequency day ratio (n=47 vs. n=47)		1:3–1:6
1:1	0	
1:2	2 (4.3)	
1:3	10 (21.3)	
1:4	15 (31.9)	
1:5	16 (34.0)	
>1:5	4 (8.5)	

Values are presented as number, number (%), mean (range), or mean± standard deviation. Data not collected are presented as (-).

centers had a mean of 2.4 surgeons per center (range, 2–5 surgeons), while community-based centers had an average of 1.0 surgeons per center (range, 1–2 surgeons). In comparison, in 2021, university-based centers had an average of 4.5 surgeons per center (range, 2–9 surgeons), while community-based centers had an average of 2.3 (range, 1–3). Additionally, the on-call ratio dropped from 1:3–1:6 in 2004 to an average of 1:5 in 2021.

Thoracic surgery unit and thoracic-associated services

Limited data exist on personnel and services related to thoracic surgery, as well as their quantities. This lack of information hampers a crucial aspect of evaluating the current standards of thoracic surgical practice in Canada. The data collected from this survey reveal that the majority (73.1%) of respondents practiced in a dedicated thoracic surgery geographic unit, with an average of 17.4±6.6 beds per center (Table 3). Notably, the frequencies of patient planning rounds (57.7% versus 37.5%) and tumor board rounds (96.2% versus 71.9%) were increased in 2021 relative to 2004, while a 5.3% decrease was evident in quality assurance rounds, such as morbidity and mortality rounds. As the number of dedicated thoracic geographic units has grown, so too has access to allied support staff. The trends in services associated with thoracic surgery demonstrated a marked increase in access to thoracic radiologists (68% versus 81%), pathologists (56% versus 69%), and cytopathologists (50% versus 62%) between 2004 and 2021, respectively.

Thoracic resource equipment and radiological sciences

The literature concerning adherence to thoracic surgery practice standards in Canada, particularly in relation to resource availability, is sparse. This issue is best addressed through surgeons' reports on the quantity of equipment or services available per center. For instance, all respondents indicated that they had access to an endoscopy unit, and 73.1% reported access to both endobronchial ultrasound and endoscopic ultrasound (Table 4). Furthermore, over the past decade, access to positron emission tomography (PET) scanners has risen by 63.9%. Respondents reported an average of 0.9±0.6 scanners per center. Over the past 2 decades, access to magnetic resonance imaging scanners has also increased, exhibiting a 12% rise.

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Table 3. Thoracic surgery units and associated services across centers

Characteristic	Year	
	2021	2004
No. of centers	26	32
Dedicated thoracic surgery geographic unit		
Yes	19 (73.1)	17 (53.0)
Average no. of beds	17.4±6.6	-
No	7 (26.9)	15 (47.0)
Do you hold the following rounds in your unit?		
Thoracic clinic practice meetings	13 (50.0)	16 (50.0)
Thoracic patient planning rounds	15 (57.7)	12 (37.5)
Quality assurance rounds (i.e., morbidity and mortality)	23 (88.5)	30 (93.8)
Tumor board rounds	25 (96.2)	23 (71.9)
Access to house staff support		
Thoracic surgery residency program		
Active	12 (46.2)	16.4 (51.0)
None	11 (42.3)	-
General surgery residency program		
Active	19 (73.1)	17 (53.0)
None	7 (26.9)	-
Intern/family medicine residency program		
Active	17 (65.4)	16 (50.0)
None	10 (38.5)	-
Available thoracic-associated services (yes)		
Thoracic radiologists	21 (80.8)	22 (68.0)
Medical oncologists	21 (80.8)	28 (88.0)
Radiation oncologists	20 (76.9)	25 (78.0)
Pathologists	18 (69.2)	18 (56.0)
Cytopathologist	16 (61.5)	16 (50.0)
Respirologist	22 (84.6)	32 (100.0)
Gastroenterologist	22 (84.6)	32 (100.0)
Anesthesiologist	16 (61.5)	-
Dietitian/nutritionists	20 (76.9)	-
Thoracic nurses	15 (57.7)	-
Physiotherapist	18 (69.2)	-
Average no. of available thoracic-associated services		
Thoracic radiologists	2.9±2.2	-
Medical oncologists	4.4±1.9	-
Radiation oncologists	4.5±1.8	-
Pathologists	1.9±1.6	-
Cytopathologist	1.9±1.7	-
Respirologist	11.8±8.0	10.5±0.0
Gastroenterologist	11.3±8.2	8.9±0.0
Anesthesiologist	3.2±3.5	-
Dietitian/nutritionists	1.5±0.9	-
Thoracic nurses	12.6±12.9	-
Physiotherapist	1.8±1.3	-

Values are presented as number, number (%), or mean±standard deviation. Data not collected are presented as (-).

Trends in surgical case volumes and associated wait times

Growth in the patient population served, as well as the use of resources and equipment, can correspond with or even directly cause increases in case volume and wait times. The reported annual case volumes rose from 2004 to 2021 for various procedures. For lung cancer resections, the increase was from a mean of 128 (range, 20–325) in 2004 to 238.7 (range, 40–650) in 2021. Esophageal resec-

Table 4. Thoracic resource equipment and radiological sciences across centers

Characteristic	Year	
	2021	2004
No. of centers	26	32
Availability of endoscopy unit	26 (100.0)	29 (91.0)
Only endoscopy	3 (11.5)	-
With EBUS	1 (3.8)	-
With EUS	7 (26.9)	-
With EBUS and EUS	19 (73.1)	-
Esophageal motility lab	17 (65.4)	27 (84.0)
Availability of percutaneous biopsy service personnel (yes)	26 (100.0)	32 (100.0)
Average no. of percutaneous biopsy service personnel	4.1±2.4	-
Availability of CT scanners (yes)	25 (96.2)	32 (100.0)
Average no. of CT scanners	4.1±2.4	-
Availability of MRI scanners (yes)	26 (100.0)	28 (88.0)
Average no. of MRI scanners	2.1±0.9	-
Availability of PET scanners (yes)	20 (76.9)	4 (13.0)
Average no. of PET scanners	0.9±0.6	-

Values are presented as number, number (%), or mean±standard deviation. Data not collected are presented as (-).
EBUS, endobronchial ultrasound; EUS, endoscopic ultrasound; CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography.

Table 5. Annual surgical case volumes and associated wait times across centers

Characteristic	Year	
	2021	2004
No. of centers	26	32
Annual average no. of resections per center		
Lung resections	238.7 (40–650)	128 (20–325)
Esophageal resections	38.7 (1–100)	19 (0–70)
Mediastinal resections	29.9 (5–100)	13 (0–50)
Hiatus hernia repair	46.9 (10–300)	20 (0–60)
Lung volume reduction surgery	1.0 (0–10)	1.6 (0–8)
Average length of time from referral to first office visit per center (day)		
Lung cancer	9.5 (5–30)	-
Esophageal cancer	8.2 (2–30)	-
Mediastinal cancer	9.2 (3–30)	-
Average length of time from first office visit to surgical intervention per center (day)		
Lung cancer	34.0 (3–60)	29 (14–60)
Esophageal cancer	70.7 (10–140)	28 (7–90)
Mediastinal cancer	31.5 (7–60)	27 (6–60)

Values are presented as number of mean (range). Data not collected are presented as (-).

tions rose from a mean of 19 (range, 0–70) to 38.7 (range, 1–100), mediastinal resections from 12 (range, 0–50) to 29.9 (range, 5–100), and hiatus hernia repairs from 20 (range, 0–60) to 46.9 (range, 10–300) (Table 5). While the wait times for lung cancer from the initial office visit to surgical intervention have remained steady, the wait times for esophageal cancer have roughly tripled, increasing from a mean of 28 days (range, 7–90 days) in 2004 to 70.7 days (range, 10–140 days) in 2021.

Highest-ranked rate-limiting steps

Respondents assigned rankings to the most common rate-limiting steps encountered in each type of operation, with 1 being the most and 6 being the least rate-limiting (Table 6, Fig. 1). Over the past 2 decades, operating room availability and radiology turnaround time have remained the top barriers to surgical care across the majority of operations.

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Table 6. Highest-ranked rate-limiting steps

Operation type	OR availability	Radiology	Pathology	Endoscopy	Bed availability	ICU/critical care bed availability
2021 (n=34 respondents)						
Lung cancer	1	2	5	3	4	6
Esophageal cancer	1	2	5	3	4	6
Mediastinal resections	1	2	3	5	4	6
Hiatal hernia repair	1	4	5	2	3	6
2004 (n=44 respondents)						
Lung cancer	1	2	6	5	3	4
Esophageal cancer	1	2	6	5	3	4
Mediastinal resections	1	2	5	6	3	4
Hiatal hernia repair	1	4	5	3	2	6

OR, operating room; ICU, intensive care unit.

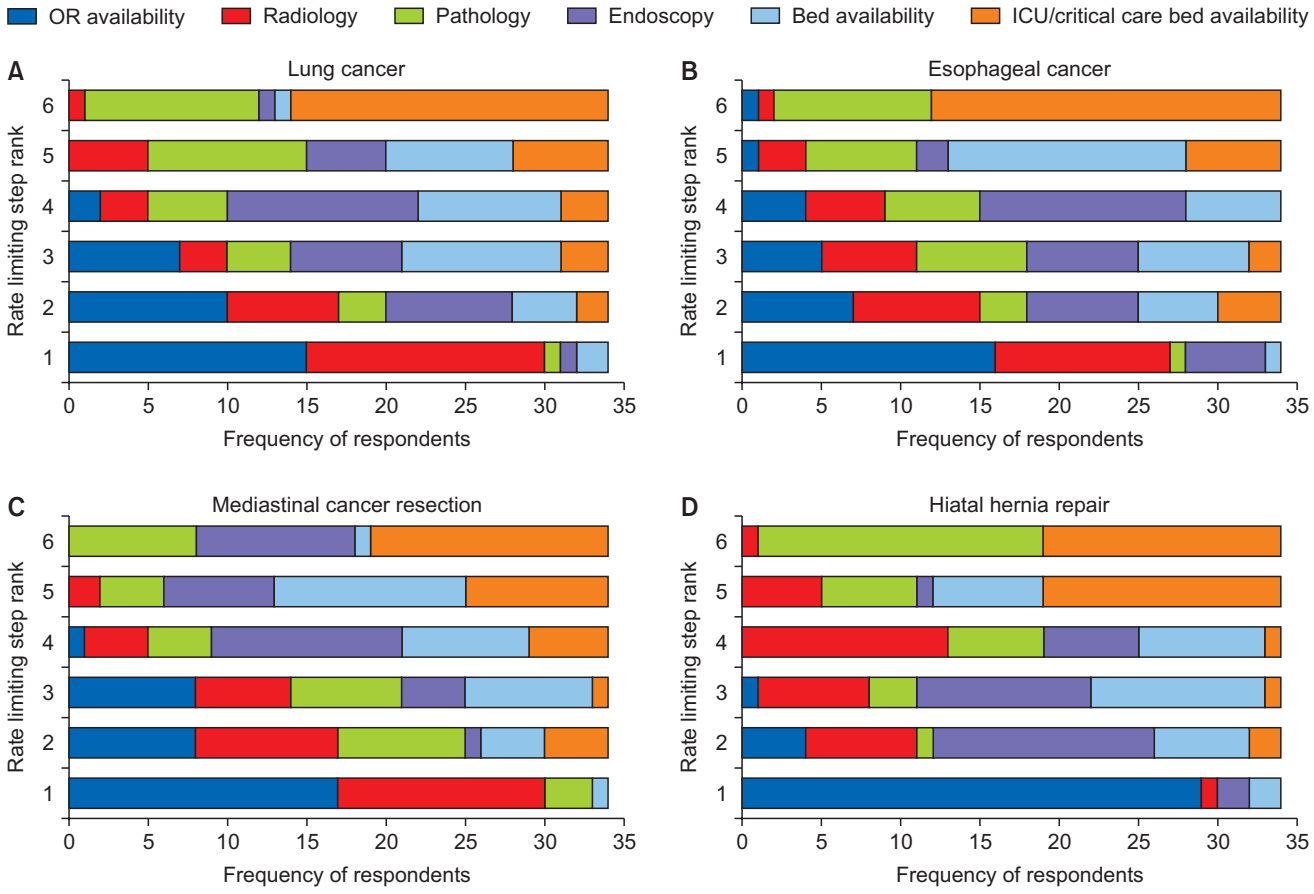

Fig. 1. Relative frequency of the distribution of rate-limiting steps as identified by respondents, categorized by operation type: (A) lung cancer, (B) Esophageal cancer, (C) mediastinal cancer resection, and (D) hiatal hernia repair. Rank 1 represents the highest barrier and rank 6 the lowest (n=34). OR, operating room; ICU, intensive care unit.

Surgeon satisfaction and compliance: 2004 article

Surgeons have reported satisfaction rates of 70.6% in terms of both income and career, with an average anticipated retirement age of 63.9±6.4 years (Table 7). Approximately 65% were aware of the 2004 paper [3], and 35% were able to leverage the results to obtain or update their equipment and resources. This allowed them to align their insti-

Table 7. Surgeon satisfaction and compliance: 2004 article (year: 2021)

Characteristic	Value
No. of respondents	34
Satisfaction with income	
Dissatisfied	5 (14.7)
Not satisfied/not dissatisfied	5 (14.7)
Satisfied	20 (58.8)
Very satisfied	4 (11.8)
Current career satisfaction	
Dissatisfied	2 (5.9)
Not satisfied/not dissatisfied	8 (23.5)
Satisfied	14 (41.2)
Very satisfied	10 (29.4)
Anticipated age of retirement (yr)	63.9±6.4
Have you referred to or used the 2004 paper "The practice of thoracic surgery in Canada [3]" to apply for or obtain up-to-date equipment/resources or revise your own institutional practices in order to comply with the standards of thoracic surgery in Canada?	
Yes	12 (35.3)
No	17 (50.0)
Unaware of paper	5 (14.7)

Values are presented as number, number (%), or mean±standard deviation.

tutional practices with the standards of thoracic surgery in Canada.

Discussion

The purpose of this survey was to address and quantify the compliance of institutions, as reported by surgeons, with the thoracic surgery practice standards established by CPAC [5]. It also provides surgeons with an opportunity to identify their capacity and resource needs. The updating of practice standards requires relevant data on the current practice environment and detailed reporting on resources, such as workforce, equipment, and associated services, to better inform future guidelines. This survey builds on the questions posed at the 2001 CATS consensus conference [3], at which the current scope of practice was discussed and the standards of practice were formally reviewed. Additionally, discussions were held on the diagnosis and management of diseases of the lung, esophagus, bronchus, pleura, and foregut, with reference to the necessary workforce, resources, and associated services in the practice setting. This model was subsequently updated by Sundaresan et al. [4] and CPAC's 2019 Pan-Canadian Standards for Cancer Surgery [5]. However, limited data exist regarding compliance as reported by surgeons and institutions, hampering the ability of surgeons to establish departmental or institutional benchmarks for quality performance.

This survey reveals that most practicing surgeons are male (70.8%), with female surgeons making up 23% of the demographic. The average age of the respondents fell within the 50- to 60-year age bracket, with a mean age of 50.3±9.5 years. In a workforce survey conducted by Grondin et al. [14], the mean age of practicing surgeons was reported to be 47.7±9.5 years. This suggests a younger demographic of respondents, which alleviates concerns about a potential manpower shortage, but raises concerns for current and future graduates [8]. Although this survey does not provide a report on the diversity of thoracic surgeons across Canada, CATS recently conducted an internal review of the association [17]. The review found that both women (21%) and people of color (41%) are underrepresented in the profession and within the association. As a result, plans have been formulated to establish an Equity, Diversity, and Inclusion Task Force to address these areas of concern [17]. The retention of trainees aligns with the literature [14], with 93.7% of respondents having received their thoracic surgery RCPSC certification in Canada. Most of these thoracic surgeons are located in the province of Ontario (45.8%). All centers adhere to the "surgeon" or "competency criteria" as outlined by CPAC [5].

Most respondents are employed in an academic-affiliated practice setting (93.7%), with an average of 4.5 (range, 2–9) full-time thoracic surgeons per center. Additionally, 69% serve a population of over 1 million patients. This reflects the increasingly successful regionalization of thoracic surgical care in Canada, while aligning with the recommended CPAC standards of a minimum of 3 surgeons per center [5]. Improvements have also been made in the current on-call frequency ratios, which have decreased from 1:3–1:6 to 1:5, as reported by the largest proportion of respondents (34%) in this study. This suggests a trend towards adequate staffing and a potential reduction in physician burnout. While further research is required on the latter point, the survey does indicate that surgeons are generally satisfied with their income (71%) and career (71%) (Table 7). Therefore, the outlook for the Canadian thoracic surgery workforce remains positive, with promising long-term retention prospects. Respondents indicated that they anticipate retiring at approximately 63.9±6.4 years of age.

With improvements in regionalization, increased capacity is becoming available to thoracic surgical patients and surgeons. Thoracic surgeons have reported a 20% increase in dedicated thoracic surgery beds, accompanied by an overall 9% increase in multi-disciplinary rounds. However, a 5% decrease was noted in quality assurance rounds,

which could potentially be due to a low response rate. In 2009, Ivanovic and colleagues conducted a survey among CATS members, revealing a high level of interest (97.8%) in sharing data on morbidity, mortality, and surgical wait times on a national scale [11]. The key finding of this survey was the increased availability of services related to thoracic surgery over the past 2 decades. The majority of surgeons now have improved access to thoracic radiologists (81%) and medical oncologists (81%), while maintaining access to thoracic radiation oncologists, pathologists, cytopathologists, respirologists, and gastroenterologists. For the first time, in this survey, surgeons reported having access to dedicated dietitians/nutritionists, thoracic nurses, and physiotherapists. These collaborative services and human resources align with the second theme of the CPAC standards, "practice setting" [5]. This survey provides quantitative data on the average number of personnel or services per center (Table 3). This information is crucial to inform, update, and standardize the appropriate workforce needs at these regional centers, thereby facilitating the coordination of high-quality surgical care and case management.

The availability of thoracic-related resource equipment for surgeons has increased, with all centers now reporting access to an endoscopy unit. Furthermore, 73% of these centers have access to both endobronchial ultrasound and endoscopic ultrasound. All centers also have access to percutaneous biopsy services and magnetic resonance imaging, and a 64% increase was noted in access to PET scanners since 2004, with 0.9±0.6 scanners per center. This increase aligns with the growing body of evidence from the early 2000s, particularly from landmark studies, regarding the efficacy of PET in staging lung cancer [18]. These data mirror the resource standards for practice settings as outlined by CPAC, with additional detail provided on the quantity per center (Table 3).

With the rising incidence rates of thoracic cancers and increased access to resources, the associated case volumes for lung, esophageal, and mediastinal resections have doubled since 2004 (Table 5). This increase may be attributed to factors such as an aging population, the regionalization of thoracic surgery, and a potential influx of referrals from the community. However, this surge in case volume also corresponds with an increase in wait times. The majority of respondents reported a wait time of 8–9.5 days from referral to the first office visit for lung (9.5 days; range, 5–30 days), esophageal (8.2 days; range, 2–30 days), and mediastinal cancer (9.2 days; range, 3–20 days). However, some respondents reported a wait time of 31–71 days from the first office visit to surgical intervention for lung (34.0 days; range, 3–60 days), esophageal (70.7 days; range, 10–140 days), and mediastinal cancer (31.5 days; range, 7–60 days). This represents a 15%–86% increase in wait times since 2004. In 2018, personal communication with CPAC revealed that Ontario had approximately 4,680 lung cancer cases. The pan-Canadian 5-year age-standardized survival rate for 2015–2017 was 22% (22%–23%) [19]. The percentage of patients who underwent lung cancer surgery within 6 months of an early-stage (I or II) diagnosis varied substantially across provinces in Canada, ranging from 33% to 63.9%. However, patients with stage III lung cancer generally did not receive timely surgery, and variation was present in practice across centers, as per the internal CPAC report. Furthermore, personal communication reports with Ontario Health (FY17/18-FY19/20) indicated that annual esophagectomy case volumes of fewer than 7 were associated with 30-day and 90-day mortality rates of 12% and 20%, respectively. In contrast, level 1 centers with more than 20 annual cases demonstrated 30-day and 90-day mortality rate ranges of 1%–2% and 3%–5%, respectively. These findings further underscore the importance of regionalizing dedicated centers.

The root causes of increasing wait times are multifactorial in nature. However, if surgeons transparently report limitations in resources and equipment, it can empower them to use national performance data as a tool to encourage institutional compliance to practice standards. Most surgeons reported operating room availability and radiology turnaround time as prominent rate-limiting steps in patient management (Table 6, Fig. 1). This has remained consistent since 2004, with Grondin et al. [14] confirming in 2013 that insufficient operating time is a constraint on the delivery of care. While these findings align with the CPAC practice standards, further revisions are needed in collaboration with CATS. These changes should address the resource and equipment requirements relative to population size at regional centers, thus more effectively tackling the worrying increase in wait times. Over 85% of respondents were familiar with the 2004 practice standards paper, which enabled 35% of them to request internal resources, equipment, or thoracic-related services in order to comply with the consensus conference standards [3].

Limitations

This survey study had some potential limitations. Given the limited response rate (33.8%), the results may represent only a snapshot of the thoracic surgery practice in Canada

in 2021, specifically within the confines of academic CATS members, who made up 93.7% of respondents. Therefore, these findings may not be generalizable to community practice. The survey was conducted 18 months after the onset of coronavirus disease 2019, in September 2021, which could have impacted the response rate and the accuracy of responses. Furthermore, participants may have introduced recall bias in response to questions requiring them to report data not immediately at their disposal, such as the number of computed tomography scanners, leading to approximations.

Conclusion

In this 2021 survey study, we outlined the trends in thoracic surgery practice, emphasizing current demographics, workforce composition, resource availability, rate-limiting steps, and job satisfaction. We evaluated surgeon-reported metrics for adherence to the CPAC Pan-Canadian Cancer Surgery Standards. Over the past 20 years, resource allocation has increased, followed by an expanded capacity of personnel associated with thoracic surgery and an increase in case volumes. However, the wait times associated with these procedures have approximately doubled, while the limiting factors in surgical care have remained constant, with operating room availability and radiology turnaround times posing prominent barriers. Given the increasingly aging population, we plan to conduct a survey of the CATS membership in 5 years to better address changes in compliance, enhance survey response, and redefine practice standards related to resource allocation quantity. By assessing the compliance of individual surgeons and thoracic surgery centers across Canada, we can identify the effectiveness of practice standards and provide a transparent performance benchmark for surgeons.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Supplementary materials

Supplementary materials can be found via https://doi.org/10.5090/jcs.23.093. **Supplementary Material 1**. A survey of the Canadian Association of Thoracic Surgeons.

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