European Journal of Cardio-Thoracic Surgery 45 (2014) 779–786
doi:10.1093/ejcts/ezu016 Advance Access publication 20 February 2014

European guidelines on structure and qualification of general thoracic surgery

Chairs: Alessandro Brunelli[a,*] and Pierre Emmanuel Falcoz[b]

Panel: Thomas D'Amico[c], Henrik Hansen[d], Eric Lim[e], Gilbert Massard[b], Thomas W. Rice[f], Gaetano Rocco[g], Pascal Thomas[h], Dirk Van Raemdonck[i], Miguel Congregado[j], Herbert Decaluwe[i], Tomasz Grodzki[k], Toni Lerut[i], Thomas Molnar[l], Michele Salati[m], Marco Scarci[n], Paul Van Schil[o], Gonzalo Varela[p], Federico Venuta[q], Franca Melfi[r], Cengiz Gebitekin[s], Jaroslaw Kuzdzal[t], Gunda Leschber[u], Isabelle Opitz[v], Kostas Papagiannopoulos[a], Alec Patterson[w], Enrico Ruffini[x], Walter Klepetko[y] and Alper Toker[z]

[a] St James's University Hospital, Leeds, UK
[b] Strasbourg University Hospital, Strasbourg, France
[c] Duke University, Durham, NC, USA
[d] Rigshospitalet University of Copenhagen, Copenhagen, Denmark
[e] Royal Brompton Hospital, London, UK
[f] Cleveland Clinic, Cleveland, OH, USA
[g] Istituto Nazionale Tumori, Fondazione Pascale, IRCCS, Naples, Italy
[h] Aix-Marseille University and Hospitals System of Marseille, Marseille, France
[i] University Hospitals Leuven, Leuven, Belgium
[j] University Hospital Virgen Macarena, Seville, Spain
[k] Pomeranian Medical University, Szczecin, Poland
[l] University Medical School of Pecs, Pecs, Hungary
[m] Ospedali Riuniti Ancona, Ancona, Italy
[n] Papworth Hospital NHS Foundation Trust, Papworth Everard, UK
[o] University Hospital of Antwerp, Antwerp, Belgium
[p] Salamanca University Hospital, Salamanca, Spain
[q] University of Rome Sapienza - Fondazione Eleonora Lorillard Spencer Cenci, Rome, Italy
[r] University of Pisa, Pisa, Italy
[s] Uludag University, Bursa, Turkey
[t] Department of Thoracic Surgery, Jagiellonian University Collegium Medicum, John Paul II Hospital, Krakow, Poland
[u] ELK Berlin Chest Hospital, Berlin, Germany
[v] University Hospital Zurich, Zurich, Switzerland
[w] Washington University, St Louis, MO, USA
[x] University of Torino, Torino, Italy
[y] Medical University of Vienna, Vienna, Austria
[z] Istanbul Medical Faculty, Istanbul, Turkey

* Corresponding author. Department of Thoracic Surgery, St James's University Hospital, Level 3, Bexley Wing, Beckett Street, Leeds LS9 7TF, UK. Tel: +44-113-2068776; fax: +44-113-2068824; e-mail: brunellialex@gmail.com (A. Brunelli).

Received 24 October 2013; received in revised form 22 December 2013; accepted 30 December 2013

Abstract

OBJECTIVE: To update the recommendations for the structural characteristics of general thoracic surgery (GTS) in Europe in order to provide a document that can be used as a guide for harmonizing the general thoracic surgical practice in Europe.

METHODS: A task force was created to set the structural, procedural and qualification characteristics of a European GTS unit. These criteria were endorsed by the Executive Committee of the European Society of Thoracic Surgeons and by the Thoracic Domain of the European Association for Cardio-Thoracic Surgery and were validated by the European Board of Thoracic Surgery at European Union of Medical Specialists.

RESULTS: Criteria regarding definition and scope of GTS, structure and qualification of GTS unit, training and education and recommendations for subjects of particular interest (lung transplant, oesophageal surgery, minimally invasive thoracic surgery, quality surveillance) were developed.

CONCLUSIONS: This document will hopefully represent the first step of a process of revision of the modern thoracic surgeons' curricula, which need to be qualitatively rethought in the setting of the qualification process. The structural criteria highlighted in the present

document are meant to help and tackle the challenge of cultural and language barriers as well as of widely varying national training programmes.

Keywords: General thoracic surgery • Qualification • Structure • Education • Accreditation • Procedures • Professional affairs

INTRODUCTION

General thoracic surgery (GTS) must be performed by qualified surgeons specialized in GTS according to European or national regulations and practising in dedicated GTS units with appropriate characteristics.

In this regard, a number of publications have shown consistent short-term and long-term benefits in managing oncological thoracic procedures by specialized thoracic surgeons vs non-specialists [1–5].

In the light of more recent European quality initiatives and educational activities, the present document has been conceived to revise and update the original recommendations for the structural characteristics of GTS in Europe proposed more than a decade ago by the European Association for Cardio-Thoracic Surgery (EACTS) and the European Society of Thoracic Surgeons (ESTS) [6].

The objective is to provide a comprehensive document that may serve as a guide for harmonizing the general thoracic surgical practice in Europe.

METHODS

The executive committee of the ESTS appointed two co-chairs to create a task force aimed at developing recommendations about structural organization of a GTS unit in Europe. A call was sent by email to the membership in August 2012 and several thoracic surgeons expressed their interest and actively contributed to this project.

The first part of the project consisted in updating and revising the relevant paragraphs of the joint EACTS/ESTS paper on the structure of thoracic surgery in Europe [6]. An online survey was then sent to the panellists to reach consensus about controversial issues raised during the revision process.

Featured paragraphs concerning topical subjects of particular interest were assigned to specific authors selected by the chairmen for their expertise and integrated into the final manuscript.

The manuscript was circulated among all panellists for comments and remarks, which were taken into consideration to develop its final version.

Most of the work was performed by email or conference call.

The final document was then submitted to the national thoracic delegates of all European Countries officially representing their Country in the Division of Thoracic Surgery within the structure of the European Union of Medical Specialists (UEMS) for additional review and comments. The final version was approved by the ESTS Executive Committee and by the EACTS Thoracic Domain.

Most of the recommendations in this document are based on experts' opinions. Although best available direct and indirect scientific evidence was taken into account as much as we could, the latter is scanty or completely absent for most of the topics. The problem becomes critical when stating recommendations for the numbers of procedures for training and/or qualifying surgeons and units. Recently published retrospective analyses and systematic reviews of the literature [7–9] have shown that patients can expect better outcomes if they are operated on in high-volume centres (the evidence is not as clear for individual surgeons) by specialized surgeons. Unfortunately, evidence on the number of procedures needed to reach excellence in thoracic surgical practice is lacking. That is why we have made any effort to agree on the number of procedures all along the manuscript according to the experts' experience.

DEFINITION AND SCOPE OF GENERAL THORACIC SURGERY

GTS is a surgical specialty dealing with diagnosis and management of congenital or acquired diseases of the chest, including disease of chest wall, pleura, lungs, airways, mediastinum, diaphragm and oesophagus.

For the purposes of this document, general thoracic procedures can be divided into minor, major and large/specialistic according to their complexity and costs, the latter requiring specific training and dedication due to their complexity and low numbers:

(i) Minor procedures (performed without general anaesthesia and including but not limited to diagnostic endoscopies, sampling/biopsies, chest drainages and pleurodesis, etc.).
(ii) Major procedures (performed with general anaesthesia and assisted ventilation and including but not limited to all standard lung resections, mediastinal tumours, non-resectional oesophageal surgery, surgical infection management, pleural space/chest wall operations, etc.).
(iii) Large/specialistic procedures (including but not limited to tracheal surgery, oesophageal resections, lung transplantations, extrapleural pneumonectomy, extracorporeal membrane oxygenation, hyperthermic chemotherapy, etc.).

A surgeon practising GTS must have an extensive and updated knowledge of all aspects of pathophysiology, epidemiology, diagnosis, treatment and postoperative care of patients with surgical disease of the chest.

Surgeons working in a GTS unit must be competent in all domains of a general thoracic surgical practice: preoperative, intraoperative and postoperative. They must be able to participate in multidisciplinary team discussions on treatment of disease of the chest.

The following procedures should be part of the clinical and surgical competence of all GTS teams.

(i) Resection, reconstruction, repair and diagnosis of the lung for benign or malignant disease or injury.
(ii) Operations for chest wall and pleural space pathologies, including diagnosis, resection and reconstruction for neoplasms, infections or necrosis, thoracoplasty and repair of

chest wall deformities, as well as the management of traumatic chest wall disorders with or without instability.
(iii) Surgical procedures of the mediastinum, including biopsy and resection of neoplasms and cysts, drainage of infections, mediastinal lymphadenectomy, mediastinotomy, mediastinoscopy and other video-assisted or open mediastinal approaches.
(iv) Resection, reconstruction and drainage of the pericardium.
(v) Diagnostic and therapeutic endoscopic procedures using both the flexible and rigid scopes and instrumentation of the tracheobronchial tree and oesophagus and assisted by image guided means.
(vi) Biopsy of the cervical, mediastinal and axillary lymph nodes.
(vii) Surgery of the thoracic sympathetic nerves.
(viii) Surgical procedures of the thoracic outlet.
(ix) Procedures for airway control, including tracheostomy, tracheal intubation and endoluminal procedures.
(x) Procedures to manage diseases of the pleura and pleural space problems, including management of primary or secondary pleural neoplasms, pleural effusion, pneumothorax and thoracic empyema.
(xi) Operations to provide thoracic exposure for interventions to be performed by allied specialists (i.e. cardiovascular, neurosurgeons, orthopaedics, invasive radiologists, etc.).
(xii) Functional interventional procedures to manage emphysema.
(xiii) Surgery for traumatic injuries of the chest or organs within the chest.
(xiv) Operation on vascular structures related to the management of any pathology treated within the field of GTS.
(xv) Operations to the thyroid gland in case of intrathoracic lesion (goitre or cancer).
(xvi) Providing thoracic tissue samples for diagnosis by surgical means within the frame of inter-specialty commitments whenever less aggressive methods failed.
(xvii) Management of the surgical and non-surgical complications of the procedures listed above.
(xviii) Minimally invasive approaches (videoassisted thoracoscopic surgery [VATS]/robotic surgery) to the mediastinum, oesophagus, lung and chest wall.
(xix) Ability to discuss indications, contraindications operability/resectability and prognosis of the above-mentioned surgical procedures within multidisciplinary teams.
(xx) Ability for postoperative care and management of complications consequent to the above-mentioned surgical procedures.

Teams working in centres of higher specialization should have competence in the following more complex procedures depending on their sub-specialization and qualification:

(i) Resection, reconstruction, repair and transplantation of airways for congenital and acquired (neoplasms, strictures and trauma) diseases.
(ii) Procedures for diagnosis, resection, reconstruction and repair of the oesophagus, including laparoscopic or thoracoscopic techniques and endoluminal procedures, for benign or malignant diseases.
(iii) Resection, reconstruction, repair and pacing of the diaphragm.
(iv) Pulmonary transplantation.
(v) Extracorporeal oxygenation techniques intraoperatively and in the intensive care unit (ICU): technical skill, ability to supervise a patient on extracorporeal membrane oxygenation (ECMO).

STRUCTURE AND QUALIFICATION OF GENERAL THORACIC SURGERY UNIT

Institutional status

Characteristics of high specialization and standard units are summarized in Table 1.

GTS units of high specialization should be within or in affiliation with a university or comprising a level of multidisciplinary care and specialization that is expected in a university. The unit should be headed by a surgeon preferably certified by the UEMS European Board of Thoracic Surgery (EBTS) or by an equivalent body recognized by the UEMS (national diploma of thoracic surgeon). This is in accordance with the most recent evidence from the literature showing a positive association between specialization and short-term or long-term outcomes in thoracic surgery [2–5, 7–9].

This Head of unit should have educational and scientific responsibilities and should possess a minimum experience of 5 years of clinical practice as a qualified GTS surgeon [10]. The unit should have dedicated staff and institutional resources and ideally a separate budget whenever feasible.

Standard GTS units should be either entirely freestanding or within a combined unit with cardiac/vascular/general surgery, but they should have a dedicated and separated personnel and institutional resources. The unit should be headed by a UEMS EBTS-certified surgeon or by a surgeon with an equivalent certification issued by a UEMS-recognized body (i.e. national diploma of specialization) with a minimum experience of 5 years of practice as qualified GTS surgeon.

Surgeons

GTS units should have a dedicated staff including at least one UEMS EBTS-certified (or with an equivalent certification recognized by UEMS—i.e. National Diploma of Specialization) surgeon supervising surgical activity and acting as Head of the unit plus a number of qualified (preferably UEMS EBTS-certified or with a UEMS-recognized certification of specialization—i.e. National certificate of specialization) general thoracic surgeons performing at least 100 certifiable major thoracic procedures per year per surgeon according to the definition provided in paragraph definition and scope of general thoracic surgery. Ideally, there should be one staff qualified GTS surgeon for 100 major thoracic procedures. A minimum staff of two qualified GTS surgeons should be in place to allow adequate coverage of patient care and to ensure adequate on-call arrangements. In units of higher specialization, surgical staff is expected to participate and contribute in clinical research activities. Although there is a great variability in the literature in defining high surgical volume for lung cancer surgery (from 20 to >90 resections), recent North American and European guidelines have advised that lung resection should be performed in centres with a minimum number of 20–25 anatomic lung resections per year [11, 12]. A more recent paper analysing data extracted from the UK National Cancer Data Repository showed a

Table 1: Characteristics of GTS units of standard and high specialization

GTS unit	Characteristics
High-specialization unit	Setting: within or in affiliation with a university setting Dedicated surgical ward (4–6 beds/100 major thoracic procedures) Access to dedicated Thoracic ICU Head of unit: UEMS EBTS or UEMS-recognized equivalent certification, minimum of 5 years of practice in GTS Dedicated staff and institutional resources Team: qualified general thoracic surgeons performing a minimum of 100 major thoracic procedures per year per surgeon Surgeons expected to participate in research activities One fully equipped operating theatre per 300–400 major thoracic procedures per year In addition to on-site minimum facilities[a], access to oesophageal pathophysiology laboratory; more advanced imaging techniques including MRI and on-site or collaboration with PET scanning facility; specialist laboratories relevant to sub-speciality work, such as transplantation, including ECMO facilities Minimum Institutional case-load: 300 ± 50 major thoracic procedures/year
Standard unit	Setting: freestanding or within a combined unit Dedicated staff and institutional resources Head of unit: UEMS EBTS or UEMS-recognized equivalent certification, minimum of 5 years of practice in GTS Team: qualified general thoracic surgeons performing a minimum of 100 major thoracic procedures per year per surgeon One fully equipped operating theatre per 300–400 Dedicated surgical ward (4–6 beds/100 major thoracic procedures) Access to dedicated thoracic beds within a multispeciality ICU Access to on-site support minimum facilities[a] Minimum institutional case-load: 150 ± 50

[a]See Inpatient Diagnostic Facilities for the list of minimum on-site support facilities.

strong association between procedure volume and survival after lung cancer surgery [13]. There was increased perioperative and long-term survival in hospitals performing more than 150 surgical resections per year compared with those carrying out less than 70 resections per year.

Operating theatres

There should be 1 dedicated operating theatre per 300–400 major thoracic procedures per year. A fully equipped operating theatre should include equipment for video-assisted thoracic surgery. One additional operating theatre should be available to perform minor procedures if needed.

Advanced care

GTS units of higher specialization should preferably have access to a dedicated thoracic ICU.

There should be an availability of at least 1–2 ICU beds per 300 major thoracic procedures per year. In addition, 1 Intermediate Care or High-Dependency Unit bed per 100 major thoracic procedures should be available.

Standard units should have access to a multispecialty ICU subject to ICU beds availability.

Thoracic ward

GTS units should have a dedicated thoracic surgical ward with dedicated paramedical staff and physiotherapists. Ideally, a GTS ward should have 4–6 beds available per 100 major thoracic procedures per year. In addition, GTS units should have at least one wound treatment room available on every ward and the possibility to provide barrier nursing.

Outpatient care

GTS units should have sufficient facilities for outpatient visits allowing same day access to radiology, pulmonary function tests, endoscopy and cardiological testing if needed.

Inpatient diagnostic facilities

GTS units must have access to the following on-site minimum support facilities:

(i) haematological, biochemical and microbiological laboratories;
(ii) respiratory pathophysiology laboratory;
(iii) endoscopic examinations by bronchoscopy and oesophagoscopy (including endobronchial ultrasound and endoscopic ultrasound);
(iv) radiological investigation by plain X-ray, contrast studies, ultrasound, vascular imaging and computed tomography (CT)-scan;
(v) CT or ultrasound needle biopsy;
(vi) cytology, histopathology and frozen section analysis.

GTS units of higher specialization should also have access to:

(i) oesophageal pathophysiology laboratory;
(ii) more advanced imaging techniques including magnetic resonance imaging (MRI) and positron emission tomography (PET) scanning facility;
(iii) specialist laboratories relevant to sub-speciality work, such as transplantation, including ECMO and/or cardiopulmonary bypass facilities.

Surgical activities

(i) Standard GTS units should perform a total number of major thoracic procedures (as defined in paragraph definition and

scope of general thoracic surgery) >150 (±50). Units of higher specialization should perform a total number of major thoracic procedures (as defined in paragraph definition and scope of general thoracic surgery) >300 (± 50). It must be noticed that most of the studies analysing the effect of surgical volume on outcomes deal with lung cancer operations, which represent 25–30% of the total surgical activity of a GTS unit. The term major thoracic procedures used in this paragraph refers to the generality of surgical procedures as defined in paragraph definition and scope of general thoracic surgery.

(ii) Oesophageal resections should be performed only in units with characteristics listed in Oesophageal Surgery. A minimum number of 15 resections for cancer should be performed annually [14].

(iii) Lung transplantation and its alternative procedures should be performed only in units with high specialization and with cardiac surgical facilities. Units running a lung transplant programme should have the characteristics discussed in Lung Transplantation. A minimum number of 25 transplantations should be performed annually although units should strive to increase the number of annual cases above 30 to reduce the 5-year mortality hazard ratio [15].

SPECIFIC STRUCTURAL REQUIREMENT

Lung transplantation

GTS units running a lung transplant programme:

(i) Should have a multidisciplinary team with a minimum of two pneumologists, two fully trained thoracic surgeons and a retrieval team to cover the on call 24/24 h, 365 days/year.

(ii) Should have a trained anaesthesiologist on call experienced in thoracic surgery and cardiopulmonary support.

(iii) Must have ECMO facilities and personnel trained for pre-, per- and post-transplant cardiopulmonary support of the recipient whenever needed.

(iv) Should have dedicated ICU beds and ICU personnel for post-transplant care.

(v) Should have a team of health care workers including donor and waiting list coordinators, social workers, psychologists and physiotherapists.

(vi) Should preferentially be located in or connected to a hospital with other heart or abdominal transplant programmes with laboratories for tissue typing and monitoring of immunosuppression and with physician-experts in diagnosis and treatment of infectious diseases.

Oesophageal surgery

GTS units performing oesophageal surgery:

(i) Should have the characteristics of a high-specialization unit (see Institutional Status).

(ii) Should have a dedicated staff, adequate in number and organization, to ensure that patient care is continuously provided 24 /24 h.

(iii) The operating theatre should include equipment for open, endoscopic and video-assisted surgery.

(iv) A dedicated thoracic or multispecialty ICU should be available for the care of all oesophageal patients.

(v) The care provided on the ward should be provided by a paramedical staff including dedicated nutritionists.

(vi) The following specialized facilities should be available: state-of-the-art oesophageal pathophysiology laboratory and specialist laboratories relevant to molecular biology and tissue banking.

(vii) The overall number of major oesophageal procedures per year should be more than 30 in centres of standard care and more than 70 in centres of highest specialization. Those major oesophageal procedures include: resectional and reconstructive procedures for both malignant and benign conditions.

(viii) Oesophageal resections for cancer should be performed only in units with special interest in and organization for multidisciplinary oncology treatment and should be more than 15 resections per year [14].

Advanced minimally invasive thoracic surgery programmes

Modern dedicated general thoracic units should offer a minimally invasive programme as recommended for selected procedures by the American College of Chest Physicians lung cancer management guidelines [16] and based on the results from single-institution series with propensity-matching, multi-institutional reviews and meta-analyses demonstrating superior short-term and long-term outcomes [17–21].

In all institutions, basic procedures—management of pneumothorax, bleb resections, pleural biopsies and peripheral lung biopsies in patients with no former cardiothoracic surgery or severe inflammatory or infectious disease—should be offered with a minimally invasive approach.

(i) At high-volume, specialized VATS/Robot units, more advanced procedures—anatomic lung resections, resection of mediastinal tumours, pulmonary metastasectomy and decortications—should be planned by minimally invasive approaches. In programmes with excellent experienced, even more advanced procedures—hybrid chest wall resections, sleeve lobectomy, segmentectomy and pneumonectomy—may be considered.

(ii) To maintain an appropriate experience and to be able to achieve ongoing development in a VATS/Robot lobectomy programme, the annual volume should be at least 20 VATS/Robot lobectomies per qualified surgeon [22]. This may require a specific internal agreement among the thoracic surgery staff members.

(iii) There must also be a dedicated GTS operating room (OR) staff, including OR-nurses with special interest in minimally invasive surgery.

TRAINING AND EDUCATION OF GENERAL THORACIC SURGERY IN A EUROPEAN UNIT

The development of common recommendations for training in Europe is a difficult task. The curriculum, content and duration of training in GTS differ considerably between European countries.

Indeed, the specific content and organization of the curriculum depends on the individual national regulations and is also dependent on the specific specialist recognition currently in place in each Country (general thoracic, cardiothoracic, thoracic-vascular, general surgery with specific accreditation in thoracic surgery, etc.). The following principles are based on the criteria of the UEMS Board and the American Board of Thoracic Surgery, which are accessible at the dedicated websites and may be implemented in each individual Country based on national requirements.

It will be the task of the EBTS to revise and update these criteria in the coming years and to define a core curriculum, which should apply as a common denominator to the different UEMS-affiliated countries.

Number of procedures/number of staff surgeons

The training period should maximally expose the trainee to a large volume and a large variety of general thoracic cases.

The minimum number of procedures as first surgeon per trainee should be 100 according to the UEMS EBTS criteria.

To enable a sufficient amount and variety of cases on the one hand, and a sufficient amount of mentors on the other hand, the training unit should guarantee a minimum of 300 major procedures/year, and, ideally, presence of 3 full-time staff surgeons.

Which type of cases?

There is no doubt that case-load should cover all aspects of pleural, pulmonary and central airway diseases.

The unit should routinely care for oncology (primary and secondary cancer of the lung, mediastinal tumours), infectious diseases, trauma, benign pleural disease, chest wall disorders and tracheal surgery. The spectrum of surgery should include diagnostic surgery, conventional open surgery and minimally invasive procedures.

The trainee should get exposure to perioperative care such as placement of central venous lines, tracheal intubation and tracheostomy, non-invasive and invasive ventilation and enteral and parenteral nutrition.

Additional bonus will be brought by highly specialized care such as Lung Transplantation, ECMO, robotic surgery and oesophageal surgery.

Ideally, during the training, the trainee should participate in both national and international training courses and should be exposed to other programmes and other institutions to gain experience in highly specialized procedures and care.

Trainees are encouraged to follow the educational events offered by ESTS and EACTS. One of the objectives of these schools and dedicated courses is to ascertain teaching of the basic requirements for board certification.

The end-goal of training a European thoracic surgeon is to successfully pass the examination of the UEMS EBTS.

Surgical GTS trainees who specialize in oesophageal surgery will have had part of their education in units recognized for training in oesophageal surgery, as characterized previously (see Oesophageal Surgery). Special training in oesophageal surgery needs an experience of general surgery and a minimum duration of 1 year in highly specialized units for surgery of the oesophagus.

Training in minimally invasive thoracic surgery. All residents training for a career in GTS should be able to perform basic VATS procedures and should have exposure to and experience with advanced VATS procedures, including anatomic pulmonary resections.

It is advised that the training begins with basic procedures, including straightforward VATS wedge resections, progresses to more difficult VATS wedge resections and leads to training in VATS lobectomies after ~100 basic VATS procedures and VATS wedge resections.

In order to be trained to perform VATS anatomic pulmonary resections (lobectomies and segmentectomies), the trainee should be exposed to a least 25 VATS lobectomies per year.

Training in lung transplantation. This issue is less critical, in as far as there are only a limited number of centres performing lung transplantation.

For a trainee who is getting prepared to enter a newly created transplant programme, the prerequisites are (i) extensive experience with resectional surgery and mediastinal dissection (at least 150 procedures) and (ii) experience with cardiopulmonary bypass and ECMO. It is estimated that about 10 harvest procedures are sufficient to be ready for donor lung procurement. The trainee should have participated in at least 30 transplants to get a chance for exposure to various problem situations such as Grade-3 reperfusion oedema and lobar transplantation.

Which requirements for teachers?

All staff surgeons should be UEMS EBTS certified or holding an equivalent certification recognized by UEMS (i.e. National Diploma of Specialization).

At least the head of department should be university affiliated and the faculty should have documented experience in specialty training and in training of medical students.

The faculty should be actively involved in National/European teaching activities and teachers should be evaluated yearly.

Which institutional commitment to teaching?

The following teaching activities should be guaranteed:

(i) Daily rounds and/or staff meeting, discussion of perioperative problem situations.
(ii) Complicated case discussion (either at staff meeting or at dedicated meeting).
(iii) Institutional tumour board.
(iv) Morbidity and mortality conferences.
(v) Multidisciplinary chest meetings.
(vi) Journal club.
(vii) Visiting professors/local conferences, etc.
(viii) Risk-adjusted outcomes discussion.

There should be an on-site library and/or free Internet access to major journals and teaching material, a dedicated room for teaching activities and a dedicated office for trainees. All trainees should be encouraged to participate in clinical research. Access to basic or experimental research is a bonus.

Availability of a skills lab/simulation area is a big plus.

Presence of other learners should not interfere with the trainees' curriculum (Fellows, PhD students and others).

The training unit should prepare the trainee to meet the UEMS EBTS requirements successfully.

Trainees should be encouraged to participate in ESTS and EACTS thoracic courses and other educational activities.

Institutional commitments to trainees

On-call schedules need to fit with the European Working Hours initiatives/law.

The training curriculum should involve partner specialties such as cardiovascular and visceral surgery.

STRUCTURAL ORGANIZATION AND REQUIREMENTS OF A CLINICAL RESEARCH PROGRAMME WITHIN A GENERAL THORACIC SURGERY UNIT IN EUROPE

(i) The academic programme of a GTS unit should be led by surgeon(s) with experience and expertise in clinical research as evidenced by specialized training through the acquisition of a higher (research) degree, research grants and publication output.

(ii) Once identified, GTS units should support academic surgeons with dedicated and protected (non-clinical) research time within the job framework.

(iii) GTS units undertaking clinical research should support the development of academia for surgeons in training, either as part of their GTS training or more formally for the award of a higher (research) degree.

(iv) GTS units undertaking any health care outcome research, systematic reviews and meta-analyses should have access to the services of a professional medical librarian, epidemiologist, medical statistician and/or health economist as appropriate to the research focus.

(v) GTS units that are 'developing' randomized trials as part of their clinical research programme should have access to a formal clinical trials unit and a research and development office for the administrative support of grant applications.

(vi) GTS unit 'participating' in clinical trials should have access to dedicated supporting personnel such as research managers, database managers and research nurses.

(vii) GTS units developing translational clinical research should have the access listed in points 5 and 6, and in addition access to basic science laboratories and supporting personnel (e.g. post-doctoral scientists and lab technicians).

QUALITY SURVEILLANCE

Quality surveillance has to be performed in every GTS unit. There must be a computerized documentation of all procedures performed together with a documentation of all major adverse events. Results should be analysed on a regular basis using appropriate and updated system of risk stratification.

Complications should be discussed regularly in M&M conferences and a feedback of risk-stratified individual results should be given to every surgeon.

Regular analysis of long-term follow-up should also be performed.

European Society of Thoracic Surgeons database

European GTS units should provide data to the ESTS Database. The ESTS database is a free registry created by ESTS in 2001. The current online version was launched in 2007. It runs currently on a Dendrite platform with extensive data security and frequent backups. It is a specialty-specific, procedure-specific, prospectively maintained, periodically audited and web-based electronic database, designed for quality control and performance monitoring, which allows the collection of all general thoracic procedures. It includes many risk factors, processes of care and outcomes, which are specially designed for quality control and performance audit.

The ESTS database should represent the gold standard of clinical data collection for European GTS [23].

The ESTS database is managed by a Database Committee, which is responsible for its periodical revisions and updates.

Although participation to the ESTS database is still voluntary, it is one of the mandatory eligibility criteria to be selected for the ESTS Institutional Accreditation Programme (see The ESTS Institutional Accreditation Programme).

The database allows the annual publication of a European report (the Silver Book), which is distributed to all ESTS members as a benchmark of the thoracic surgery practice in Europe.

The database can be accessed via the ESTS homepage (http://ests.org) or directly at the following link https://ests.dendrite.it/csp/ests/intellect/login.csp.

The database committee is committed to promoting a quality culture in the thoracic community by continuously upgrading the database structure and providing educational opportunities.

The European Society of Thoracic Surgeons Institutional Accreditation Programme

The ESTS Institutional Accreditation Programme is open to all thoracic surgery units participating to the ESTS database.

The aim of the programme is to set standards of good clinical practice across Europe with the intent to improve the quality of care as much as possible according to published guidelines.

To be certified, units must participate to the ESTS database for at least 2 years and have contributed a sufficient number of patients. This prerequisite is necessary to calculate a reliable Composite Performance Score (CPS), which is the metrics used to evaluate the Institutional performance [24].

In addition to their CPS, units must have certain structural, procedural and professional characteristics to be certified, which must comply with those proposed by this document. These characteristics need to be assessed and audited along a sample of data submitted to the database by an independent auditing team, which will produce an audit report to be submitted to the Database Committee. If the report will be judged satisfactory, the accreditation will be finally approved by the ESTS Council.

The accreditation will be valid for a 36-month period. After this period, the unit must apply for revalidation.

CONCLUSIONS

The focus of this document was on ensuring the quality of thoracic surgical care in Europe. In fact, new frontiers of the thoracic surgical practice mandate a more faceted involvement and a comprehensive surgical expertise imposing a requalification of surgeons participating in multidisciplinary teams of experts in lung cancer management. This document will hopefully represent the first step of a process of revision of the modern thoracic surgeons' curricula, which need to be qualitatively rethought in the setting of the qualification process. The challenge of tomorrow is the creation of a new professional profile for the thoracic surgeons in Europe against cultural and language barriers as well as widely varying national training programmes. Accordingly, the intention of the writing committee was to concentrate efforts on the quality and metrics of thoracic surgical activity more than on the quantitative structure of clinical practice in Europe.

ACKOWLEDGEMENTS

The authors thank the members of the European Board of Thoracic Surgery at UEMS for their valuable comments and advise.

Conflict of interest: none declared.

REFERENCES

[1] Martin-Ucar AE, Waller DA, Atkins JL, Swinson D, O'Byrne KJ, Peake MD. The beneficial effects of specialist thoracic surgery on the resection rate for non-small-cell lung cancer. Lung Cancer 2004;46:227–32.
[2] Silvestri GA, Handy J, Lackland D, Corley E, Reed CE. Specialists achieve better outcomes than generalists for lung cancer surgery. Chest 1998;114: 675–80.
[3] Schipper PH, Diggs BS, Ungerleider RM, Welke KF. The influence of surgeon specialty on outcomes in general thoracic surgery: a national sample 1996 to 2005. Ann Thorac Surg 2009;88:1566–72; discussion 1572–1563.
[4] Goodney PP, Lucas FL, Stukel TA, Birkmeyer JD. Surgeon specialty and operative mortality with lung resection. Ann Surg 2005;241:179–84.
[5] Farjah F, Flum DR, Varghese TK Jr, Symons RG, Wood DE. Surgeon specialty and long-term survival after pulmonary resection for lung cancer. Ann Thorac Surg 2009;87:995–1004; discussion 1005–1006.
[6] Klepetko W, Aberg TH, Lerut AE, Grodzki T, Velly JF, Walker WS *et al*. EACTS/ESTS Working Group on Structures in Thoracic Surgery. Structure of general thoracic surgery in Europe. Eur J Cardiothorac Surg 2001;20: 663–8.
[7] von Meyenfeldt EM, Gooiker GA, van Gijn W, Post PN, van de Velde CJ, Tollenaar RA *et al*. The relationship between volume or surgeon specialty and outcome in the surgical treatment of lung cancer: a systematic review and meta-analysis. J Thorac Oncol 2012;7:1170–8.
[8] Freeman RK, Dilts JR, Ascioti AJ, Giannini T, Mahidhara RJ. A comparison of quality and cost indicators by surgical specialty for lobectomyof the lung. Intraoperative oncologic staging and outcomes for lung cancer resection vary by surgeon specialty. J Thorac Cardiovasc Surg 2013;145: 68–73.
[9] Ellis MC, Diggs BS, Vetto JT, Schipper PH. Intraoperative oncologic staging and outcomes for lung cancer resection vary by surgeon specialty. Ann Thorac Surg 2011;92:1958–63.
[10] Bilimoria KY, Phillips JD, Rock CE, Hayman A, Prystowsky JB, Bentrem DJ. Effect of surgeon training, specialization, and experience on outcomes for cancer surgery: a systematic review of the literature. Ann Surg Oncol 2009; 16:1799–808.
[11] Brunelli A, Charloux A, Bolliger CT, Rocco G, Sculier JP, Varela G *et al*. European Respiratory Society and European Society of Thoracic Surgeons Joint Task Force on Fitness for Radical Therapy. ERS/ESTS clinical guidelines on fitness for radical therapy in lung cancer patients (surgery and chemo-radiotherapy). Eur Respir J 2009;34:17–41.
[12] Brunelli A, Kim AW, Berger KI, Addrizzo-Harris DJ. Physiologic evaluation of the patient with lung cancer being considered for resectional surgery: diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2013; 143(Suppl):e166S–90S.
[13] Lüchtenborg M, Riaz SP, Coupland VH, Lim E, Jakobsen E, Krasnik M *et al*. High procedure volume is strongly associated with improved survival after lung cancer surgery. J Clin Oncol 2013;31:3141–6.
[14] Birkmeyer JD, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. NEJM 2003; 349:2117–27.
[15] Yusen RD, Christie JD, Edwards LB, Kucheryavaya AY, Benden C, Dipchand AI *et al*. International Society for Heart and Lung Transplantation. The Registry of the International Society for Heart and Lung Transplantation: thirtieth adult lung and heart-lung transplant report—2013; focus theme: age. J Heart Lung Transplant 2013;32:965–78.
[16] Howington JA, Blum MG, Chang AC, Balekian AA, Murthy SC. Treatment of stage I and II non-small cell lung cancer: diagnosis and management of lung cancer, 3r ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2013;143 (Suppl):e278S–313S.
[17] Villamizar NR, Darrabie MD, Burfeind WR, Petersen RP, Onaitis MW, Toloza EM *et al*. Thoracoscopic lobectomy is associated with lower morbidity compared to thoracotomy. J Thorac Cardiovasc Surg 2009;138: 419–25.
[18] Paul S, Altorki NK, Sheng S, Lee PC, Harpole DH, Onaitis MW *et al*. Thoracoscopic lobectomy is associated with lower morbidity than open lobectomy: a propensity-matched analysis from the STS Database. J Thorac Cardiovasc Surg 2010;139:366–78.
[19] Yan TD, Black D, Bannon PG, McCaughan BC. Systematic review and meta-analysis of randomized and nonrandomized trials on safety and efficacy of video-assisted thoracic surgery lobectomy for early-stage non-small-cell lung cancer. J Clin Oncol 2009;27:2553–62.
[20] Cao C, Manganas C, Ang SC, Yan TD. A meta-analysis of unmatched and matched patients comparing video-assisted thoracoscopic lobectomy and conventional open lobectomy. Ann Cardiothorac Surg 2012;1: 16–23.
[21] Chen FF, Zhang D, Wang YL, Xiong B. Video-assisted thoracoscopic surgery lobectomy versus open lobectomy in patients with clinical stage non-small cell lung cancer: a meta-analysis. Eur J Surg Oncol 2013;39: 957–63.
[22] Yan TD, Cao C, D'Amico TA, Demmy TL, He J, Hansen H *et al*. Video-assisted thoracoscopic surgery lobectomy at 20 years: a consensus statement. Eur J Cardiothorac Surg 2014;45:633–9.
[23] Brunelli A, Varela G, Berrisford R, Rocco G. Audit, quality control and performance in thoracic surgery—a European perspective. Thorac Surg Clin 2007;17:387–93.
[24] Brunelli A, Berrisford RG, Rocco G, Varela G; European Society of Thoracic Surgeons Database Committee the European Thoracic Database project. Composite performance score to measure quality of care major lung resection. Eur J Cardiothorac Surg 2009;35: 769–74.