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European Journal of Cardio-thoracic Surgery 40 (2011) 816—825

EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

www.elsevier.com/locate/ejcts

Review

A competency framework in cardiothoracic surgery for training and revalidation — an international comparison

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Received 24 October 2010; received in revised form 27 December 2010; accepted 4 January 2011; Available online 26 February 2011

Summary

The conventional methods of education, certification and recertification in cardiothoracic surgery face a paradigm shift in line with recent innovations in diagnostics and therapeutics. The attributes of a competent clinician entail proficiency in knowledge, communication, teamwork, management, health advocacy, professionalism and technical skills. This article investigates the skills required for a cardiothoracic surgeon to be competent. The relevant practice of certification and recertification across various regions has also been explored. Validated and competency-based curricula should be designed to develop core competencies to successfully integrate them into practice. Challenges to the implementation of such curricula and potential solutions are explored. Patient safety remains the ultimate aim to ensure excellence of both competency and performance.

Keywords: Skill; Training; Assessment; Education; Cardiothoracic; Competence

1. Introduction

Technological advancements of catheter-based techniques in cardiology, interventional radiology and vascular surgery have altered and challenged the need for established cardiothoracic procedures [1]. Diagnostic and therapeutic innovations in cardiothoracic surgery have also influenced the prerequisites to overcome the effects of learning curves [2]. Current changes in referral practice request ever more complex procedures frequently involving an elderly population with increased co-morbidities. A heightened sense of patient safety, public accountability and reduced working hours, further challenges training in this specialty [3—5]. Nevertheless, cardiothoracic surgery remains exposed to the high risk of adverse events, significantly challenging the competence and performance of the surgeon. Yet, training and evaluating competence remain the least systematic or standardised elements of surgical education [6]. Cardiothoracic surgeons today have a 'mission critical' mandate to develop education for trainees and specialists alike [1,7].

This article aims to investigate the components of competency required of a cardiothoracic practitioner. The development and assessment of technical and non-technical skills have been illustrated. Barriers to the implementation of competency-based curricula are explored, and potential solutions are discussed. Finally, the practice of certification and recertification across various regions is also described as it is strongly related to maintenance of competent cardiothoracic professionals.

2. Components of competence

Proficient practice requires competence in technical and non-technical skills. The Royal College of Physicians and Surgeons of Canada (RCPSC) has outlined key competencies of a clinician in the CanMEDS (Canadian Medical Education Directives for Specialists) competency framework; a medical expert, a communicator, a collaborator, a manager, a health advocate, a scholar and a professional [8]. This framework represents an amalgamation of societal need, empirical research, fellows' expertise and the College consensus since the early 1990s [8]. CanMEDS was first approved by the RCPSC's governing council in 1996 but has now been adopted worldwide. Recently, other training bodies such as General Medical Council (GMC) in the UK and the American Boards of

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1010-7940/$ — see front matter
doi:10.1016/j.ejcts.2011.01.018

Medical Specialties (ABMS) have also defined their individual frameworks.[1,2] However, the basic components of all these guidelines remain the same.

As per the traditional Halstedian 'see one, do one, teach one' methodology; tutors defined expectations of technical skill and assessed the trainees' dexterity and procedure-specific psychomotor skills [9]. Currently, competence is not merely the possession of knowledge, skills and the ability to perform the activities of a surgeon in line with expected standards.[3] Technical proficiency must be coupled with an ability to organise, innovate and co-operate with colleagues, allied health professionals and managers to fully integrate into the wider organisational environment. Competence entails a predefined set of basic criteria, which practicing surgeons have to fulfil. Superior performance depends on a surgeon's ability to excel in a dynamic setting with varying challenges. This requires additional skills and clinical experience beyond the mandate of basic competence.

3. Competency of non-technical skills

Non-technical skills entail the critical cognitive and interpersonal abilities that complement surgeons' technical abilities [10]. Most adverse events in surgery have been reported to occur as a result of failure in non-technical rather than technical performance. Communication failure is a causal factor in 43% of errors made in surgery [4]. Twenty-seven percent of the health-care claims have been found to be due to diagnostic and cognitive errors in the operating theatre [11]. For the purpose of cognitive and team training, high-risk industries such as civil aviation, nuclear power and oil exploration have traditionally employed crew resource management (CRM) to train their employees in communication, teamwork, leadership, judgment, decision-making and situational awareness [12]. Surgical education never explicitly addressed these factors until recently [10,13,14]. This section highlights the components of non-technical skills as well as methods of training and assessing each component in line with CanMEDS framework (Figs. 1 and 2). These components are important for residents and also for practicing specialists, and can be classified as follows.

3.1. Medical expert

This component entails maintaining up-to-date knowledge of the current clinical, surgical, biomedical and epidemiological concepts and application of this knowledge to provide optimal patient-centred care [8]. These attributes lead to evidence-based clinical decisions and therapeutic interventions [8]. The recognition of the limits of their own

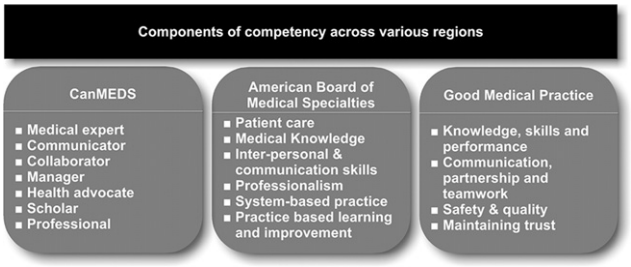

Fig. 1. Components of competence described by various educational organisations (ABMS: ABMS Maintenance of Certification, http://www.abms.org/Maintenance_of_Certification/ABMS_MOC.aspx, 2009; GMC: Good Medical Practice Appraisal Framework 28/10/2009, http://www.gmc-uk.org/Framework_4_3.pdf_snapshot.pdf. General Medical Council, 2009).

expertise and timely consultation with other health professionals is essential.

3.1.1. Developing medical expertise

The traditional repertoire consisting of clinical teaching, lectures, seminars, workshops, journal clubs and self-directed learning have been expanded by innovative computer-assisted instruction and standardised simulation models. For the specialists, lifelong development of knowledge and skills is facilitated by continuing medical education (CME) [15]. CME is an integral component of continuing professional development (CPD) that encompasses other domains required for competent practice, such as education, training, audit, management, team building and communication [16]. Through this process, cardiothoracic surgeons manage their own professional development, meet the needs

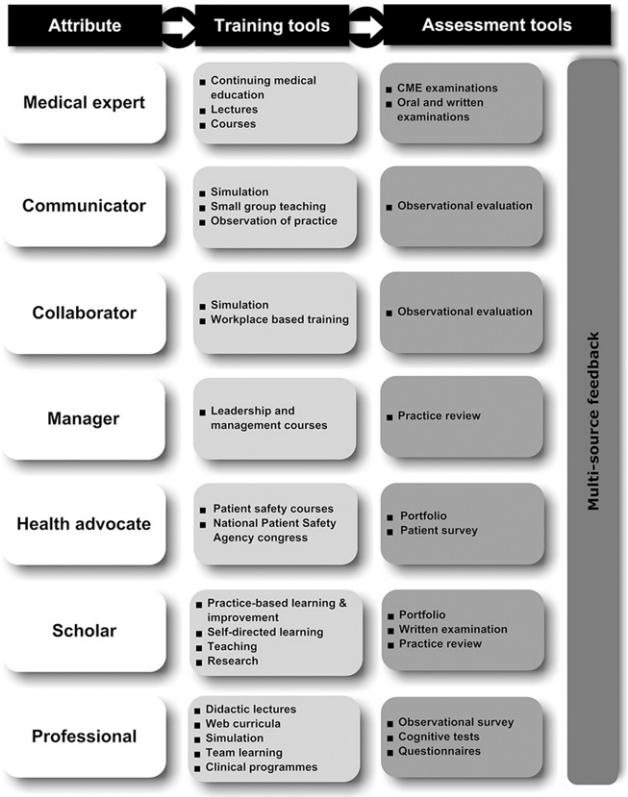

Fig. 2. Training and assessment tools.

[1] ABMS. ABMS Maintenance of Certification. http://www.abms.org/Maintenance_of_Certification/ABMS_MOC.aspx. 2009.

[2] GMC. Good Medical Practice Appraisal Framework 28/10/2009 http://www.gmc-uk.org/Framework_4_3.pdf_snapshot.pdf. General Medical Council 2009.

[3] TrainingAgency. The Concept of Occupational Competence. In: Agency T, editor. http://wwwqualityresearchinternationalcom/glossary/competencehtm. Sheffield, 1988.

Table 1. Methods to develop and assess communication skills [19].

Mode	Intervention	Description
Skill development		
Simulation	Delivering bad news didactic and small group discussion [64]	Simulated patients assess and provide feedback
Simulation	Medical interviewing standardized patient and small group discussion [65]	Trainees develop patient-centred interviewing skills
Small-group teaching	Discussion using literature and humanities [66]	Expert-led problem based learning seminars to teach communication skills
Assessment		
Checklist	SEGUE[a] Framework [67]	25-point checklist (setting the stage, eliciting information, giving information, understanding patient perspective and ending the encounter)
Checklist	Calgary-Cambridge Observation Guide [68]	28-point checklist for a clinical encounter
Rating scale	NOTSS[b] [13]	4-category behaviour rating system (situation awareness, decision-making, communication and team work)
Rating scale	NOTECHS[c] [69]	Assessment of non-technical skills using rating scale adapted from the aviation industry
Rating scale	American Board of Internal Medicine (ABMI) patient assessment [70]	Patients assess physicians' communication skills
Rating scale	Harvard Medical School Communication Skills Form [71]	5-point scale assessing communication during clinical encounter

[a] SEGUE: Set the stage, Elicit information, Give information, Understand the patient's perspective and End the encounter.
[b] NOTSS: non-technical skills for surgeons.
[c] NOTECHS: non-technical skills for surgeons.

of patients and contribute to the health service as a whole. CPD is vital for safe and resource-efficient clinical practice and specialist recertification. The current process of certification and recertification in cardiothoracic discipline lacks emphasis on CPD [17].

3.1.2. Assessing medical expertise

Structured assessment forms the foundation of recent outcome-based training curricula [18]. As the central domain of the CanMEDS framework, assessment of a medical expert consists of the evaluation of each core competency. Above all, trainees need to demonstrate clinical thinking, knowledge of clinical sciences and their application in patient care [8] (Fig. 2). Oral and written examinations in various formats have tested a trainee's decision-making in work-up, diagnosis, interpretation of findings and follow-up care [18]. Similar methods have been used during the board certification of cardiothoracic surgeons, usually involving case discussion and research.

3.2. Communicator

Cardiothoracic surgeons must exhibit interpersonal and communication skills, which allow for effective information exchange with patients, colleagues and other allied health professionals [17]. Information is shared through verbal, non-verbal and active listening skills, which are vital to developing and maintaining a therapeutic patient–physician relationship [19]. Such a relationship improves patient outcome, satisfaction and compliance with management [19,20]. These skills also allow cardiothoracic surgeons to efficiently function as an active member or leader of health-care teams and other professional groups [21].

3.2.1. Developing communication skills

In the past, communication skills' interventions were largely unstructured and ineffective [19]. Gordon et al. reported an increased rate of efficacy if evidence-based descriptions and demonstration of skills are employed with opportunities to practice relevant skills with expert feedback [22]. Acquired skills must be regularly applied in patient interactions and reinforced by tutors. Videorecording and the provision of feedback for a clinical encounter with a standardised patient significantly enhanced clinicians' communication skills [23]. Other examples include various formats of simulation and small-group teaching (Table 1).

3.2.2. Assessing communication skills

The RRC (Research Review Committee) Outcome Project, a think tank composed of US programme directors advising the Accreditation Council for Graduate Medical Education (ACGME), formulated suggestions for the assessment of communication skills following a literature review of specific competencies and consultation with experts. The group proposed to assess a resident's overall interpersonal/communication skills and their communication in challenging situations (e.g., breaking bad news, aggressive patient and frightened patient) [19]. These would be measured using a 360° assessment and focussed observational evaluation.

The 360° assessment evaluates interpersonal skills in a full circle of working relationships [19]. Professionals are evaluated by their peers and junior- and senior colleagues as well as nurses, administrative staff and allied health professionals [24]. The advantages of using this method include an improved validity and reliability of the results from various assessors, which grant the trainee a more accurate picture of their abilities [19,24]. However, this necessitates a consistently large number of evaluators reliably rating the trainees on computer systems. Other frameworks especially designed for assessing communication skills have also been developed (Table 1).

3.3. Collaborator

Successful surgery depends on effective collaboration or teamwork [25]. Cardiothoracic surgeons work closely with allied health professionals, patients and families in a complex environment for the provision of optimal patient-centred care. Surgeons must recognise limits to their knowledge, participate effectively in an interprofessional health-care team and resolve interprofessional conflict through collaborative negotiation [8,26].

Enhanced team performance has been shown to be associated with a lower rate of errors, better situational awareness and increased patient safety [27,28]. Recent advancements in surgical technology have not been paralleled by an equivalent evolution in team modelling and training [28]. An efficient team structure formalises individual roles, task allocation, authority and responsibility [28]. Cardiothoracic surgery requires intense team adaptation to both a hierarchical as well as a collaborative team structure. A hierarchical team structure is beneficial in operative procedures, whilst it would be detrimental in the planning and negotiation phase leading up to a procedure.

3.3.1. Developing teamwork

Improving teamwork involves optimising communication, co-operation, coordination, monitoring and leadership [28]. Currently, there is no formal team-training scheme in cardiothoracic surgery. An innovative method of developing team skills may be employing the simulated operating room [29]. Realistic crisis scenarios are simulated on a high-fidelity mannequin or virtual-reality simulator, challenging the skills of the entire team including surgeons, nurses and anaesthetists [29].

3.3.2. Assessing teamwork

Healey et al. suggest that broad measures of teamwork are less effective than methods more specific to a particular task and its associated demands [28]. An example of a task-dependent assessment includes observing the interactions between a surgeon and a nurse during a specific procedure. Both professionals need to co-ordinate effective bidirectional exchange of information and objects, whilst anticipating each other's needs [30]. Observation objectively assesses team performance and is especially valuable for providing feedback in team training [28]. In the simulated operating room, clinical psychologists together with senior surgeons assess individual skill, interpersonal skill and the performance of the team as a whole. All members complete self-rating forms, and compare their evaluation with those of the trainers.

3.4. Manager

Cardiothoracic surgeons play an integral role in local, regional or national organisations, effectively allocating limited resources and making practices more sustainable [8]. A manager provides leadership, supervision and active engagement in the operation of a health-care system. Surgeons must possess the ability to prioritise tasks, collaborate with colleagues as well as balance their own personal lives [8,17].

3.4.1. Developing management skills

Currently, programmes aiming to develop management skills in cardiothoracic surgeons do not exist. Training with regard to administration, finances and human resources can be given through the relevant courses and lectures. Training modules, highlighting the role of a clinician as a successful manager, need to be created by identifying the key management areas within the daily clinical practice, such as prioritising the operating lists, organising teaching sessions for juniors or even participation in the coding process.

3.4.2. Assessing management skills

Rapid advances in technology, rising costs, declining resources and increasing competition pose formidable challenges to the managerial aspects of cardiothoracic surgery. Options for formal assessment of management skill include checklists, 360° global rating scales or a review of practice [31].

3.5. Health advocate

Health advocacy involves lobbying for change in specific policies on behalf of the local population, mobilising resources as needed [8]. In response to demands for transparency and patient safety, cardiothoracic surgery represents the first specialty to nationally publicise surgical outcome data [32]. Like other clinicians, cardiothoracic surgeons also have a moral duty to improve care of patients, individual communities and the population as a whole [8].

3.5.1. Developing health advocacy

The regional organisations, such as the National Patient Safety Agency (NPSA) in the UK, help develop awareness about patient safety. These organisations aim to inform, influence and support excellence of patient care. The annual NPSA Patient Safety Congress informs health professionals on the importance of medication-related errors, incident reporting and error prevention. Patient safety principles can be taught by courses and audits at regional and national levels [17].

3.5.2. Assessing health advocacy

The health promotion activities of the trainees and specialists are ascertained using 360° global rating forms, portfolios and patient surveys [17,24,31].

3.6. Scholar

Scholars are committed not only to the creation but also to the application, translation and dissemination of medical knowledge, directly facilitating the learning of patients, colleagues and students [8,33].

The ACGME terms this process Practice-based Learning & Improvement (PBLI), which consists of five parts: monitoring practice, identifying shortcomings, planning improvement, implementing it and monitoring its impact [34]. Evidence of this process includes the use of a critical incident journal, mortality and morbidity audits and a log monitoring the outcomes of care [34].

Table 2. Methods to develop and assess attributes of a scholar[34].

Mode	Intervention	Description
Skill development		
Taught session	Mortality and morbidity conference [35]	Case analysis focusing on improvements in practice behaviours. Identification of learning-points from each case
Taught session	Exit rounds [72]	Group session with the specialists where residents identify learning points from discharged patient
Programme/curriculum	Evidence-based medicine (EBM) curriculum [73]	Trainee-led sessions discussing applications of EBM to patient care
Programme/curriculum	Practice-based small group learning programme[a]	Expert-led group discussion on clinical challenges
Assessment		
Logbook	Portfolio entry [74]	Trainees maintain record of self-directed learning and application to patient care.
Logbook	Learning plan [34]	Evaluation of written record of critical incidents
Written assessment	EBM skills test [75]	28-item test to assess trainees' understanding of EBM
Review	Physician achievement review [76]	Patients/physicians rate performance of clinical practice

[a] FMPE: Foundation for Medical Practice Education. In: (www.fmpe.org/en/programs/pbsg.html), editor, 2009.

3.6.1. Developing scholarliness

Cardiothoracic surgeons need to demonstrate commitment to being a scholar by engaging in PBLI, self-directed learning, teaching and research. Ziegelstein et al. described implementing weekly morbidity and mortality audits, trainee learning portfolios and multidisciplinary ward rounds to assess and improve practice at the Johns Hopkins Bayview Medical Center [35]. Other interventions are shown in Table 2.

3.6.2. Assessing scholarliness

Practice audits are a valuable tool for demonstrating an understanding of evidence-based medicine, critical appraisal and the impact of change in clinical practice. The data collection of surgical audits on treatment processes and outcomes can be used as a valuable tool to assess the uptake of evidence [36]. Other methods of assessing the attributes of a scholar are presented in Table 2.

3.7. Professional

A professional has the ability to satisfy the relationship-centred expectations required to practice competently through the judicious use of knowledge, technical skills, communication, clinical reasoning, emotions and values for the benefit of the individual and community [37]. Cardiothoracic surgeons are expected to demonstrate commitment to professional responsibilities, adherence to ethical principles and empathy by upholding honesty, integrity and confidentiality [31].

3.7.1. Developing professionalism

Professionalism can be developed through specific interventions aimed at beliefs, attitudes, reasoning and behaviour [38]. In addition to the observation of practice, didactic lectures and web curricula are used to portray issues on informed consent, confidentiality and cultural sensitivity [39]. Other methods include simulation, seminars, team learning and clinical programmes (Table 3).

3.7.2. Assessing professionalism

To assess professionalism, five relationships can be assessed: patient–clinician relationship (e.g., attentive, respectful, and thorough physical examination), community–clinician relationship (e.g., commitment to patient safety), health-care-system–clinician relationship (e.g.,

Table 3. Methods to develop and assess professionalism [38].

Mode	Intervention	Description
Skill development		
Lecture	Cultural sensitivity presentation [39]	Members of community discuss issues with trainees and allied health professionals
Independent learning	Web-based curriculum [77]	Didactic sessions, vignettes and quizzes on informed consent and confidentiality
Seminars	Challenging case conference [78]	Residents discuss challenging psychosocial issues that they have encountered and receive feedback
Simulation	Simulated patients (role play) [79]	Trainees interacting with simulated patients
Assessment		
Self-administered questionnaire	Scale to Measure Professional Attitudes and Behaviours in Medical Education (SMPABME) [38]	12-item questionnaire for use within workplace reporting others' behaviour
Survey	Musick 360° evaluation [80]	Allied health professionals, clinicians assess trainees
Survey	Mini-PAT[a] [81]	Multisource feedback survey for trainees and specialists
Survey	SPRAT[b] [82]	Multisource feedback survey
Survey	Wake Forest Physician Trust Scale [83]	Patients evaluate physician professionalism and patient care
Records	Hickson codes [84]	Categories of professional behaviour are coded as per patient complaints
Observational	Stern value code [85]	Assessed by trained observers using 37 qualitative criteria

[a] Mini-PAT: mini-peer assessment tool.
[b] SPRAT: Sheffield peer review assessment tool.

demonstrating mutual respect for allied health professionals), clinician–clinician relationship (e.g., teaching, interacting with colleagues and students) and self-clinician relationship (e.g., critical self-reflection on performance) [38].

Assessments that are multimodal (examinations, 360°, and simulation) involving multiple assessors (patients, colleagues and other health professionals) conducted in various settings (outpatients, operating theatre and community) are most valuable [38,40]. An array of observational surveys, cognitive tests and questionnaires has been trialled (Table 3).

4. Competency of technical skills

Traditionally, technical skills are taught in the workplace that is unstructured and based on procedural volume. The assessment also remains subjective, and is through direct observation during live procedures [41].

Current methods of assessing technical skills include procedural logbooks and various generic or procedure-specific rating scales. Logbooks reveal the volume and range of procedures a trainee has performed with no indication of qualitative performance. By contrast, rating scales such as Direct Observation of Procedural Skills (DOPS) and the Objective Structured Assessment of Technical Skill (OSATS) assess the qualitative performance of a particular surgical task, such as simulated aortic cannulation or vessel anastomosis [41,42]. Newly developed methods include the Imperial College Surgical Assessment Device (ICSAD) that tracks and analyses trainee's hand motions during a simulated or actual surgical procedure [43]. Specialist assessment can be carried out by observing practice and outcome parameters [17].

Simulation is emerging as an innovative solution to various challenges facing the specialty. These include surgical training, specialist education, skill development for new technology, enhancing patient safety and certification [44]. The ACGME has recommended the use of simulators and skill laboratories in residency curricula to train technical skills and management techniques in various scenarios [45]. Following a symposium on cardiac simulation in Cambridge, Massachusetts in 2007, the cardiothoracic surgery Boot Camp was established [46]. During the boot camp, four groups of residents rotated through four half-day sessions developing general thoracic surgery skills including small- and large-vessel anastomotic techniques on porcine heart models [44,46]. The final session focussed on cardiopulmonary bypass skills, including aortic and atrial cannulation using beating pig heart. This was designed to simulate all the procedural steps of establishing and terminating cardiopulmonary bypass. The last day also included a wet lab for valve-replacement- and aortic-root surgery. In each session, video assessment by faculty educators monitored skill development and determined if objectives were achieved prior to progression [46].

The Boot Camp successfully provided an opportunity for intensive practice in a safe learning environment independent of patient availability. Residents acquired basic technical skills and eliminated elementary errors, enabling them to fully capitalise on future valuable opportunities in the operating room [46].

5. Mentoring

Traditionally, an intimate relationship exists between the behaviour of trainees and that of their role models [47]. Mentoring uses this relationship to offer trainees key technical and non-technical skills and career advice when one's own insight, understanding and planning are lacking [48]. The mentors cast a light on the road ahead and support the mentees in their need, whilst constantly challenging them to fulfil their potential [48].

6. Certification

Training and certification practices in cardiothoracic surgery vary greatly across different regions (Fig. 3). In some countries, cardiac and thoracic surgical training are closely linked, whilst, in others, training in thoracic surgery is completely separate or forms a subspecialty of general surgery [7].

6.1. United States

The American Board of Thoracic Surgery (ABTS) maintains a single qualification for both cardiac and thoracic surgeons [7]. Most cardiothoracic trainees undergo a 5-year general surgery residency before undertaking a 2–3 year cardiothoracic residency [7]. Recently, significantly shorter integrated training programmes, with a focused 6-year cardiothoracic curriculum, are emerging [7].

Certification of the American Board of Surgery is optional for trainees, who commenced thoracic surgery residency in July 2003 or thereafter [49]. Certification requirements can be satisfied via many pathways. Commonly, the successful completion of a full ACGME-approved residency in General Surgery followed by the completion of a full ACGME-approved residency in Thoracic Surgery fulfils the requirements [49]. Operative requirements amount to approximately an annual average of 125 major operations performed by each trainee [49]. Trainees, who meet these requirements, are allowed to apply for board examination only if the programme director and the trainee's faculty certify in writing that, in their opinion, the trainee has satisfactorily completed the requirements for training and is capable of independent and competent practice.

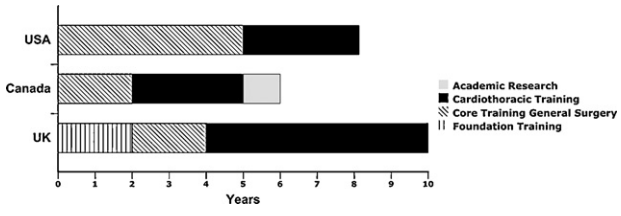

Fig. 3. Regional comparison of training programmes [7,50].

6.2. United Kingdom

In the UK, surgical training is governed by the Intercollegiate Surgical Curriculum Programme (ISCP) [50]. Post-qualification, trainees complete a 2-year foundation programme (FY1/FY2) followed by 2 years of core surgical training (CT1/CT2) before undergoing up to 6 years of specialist cardiothoracic surgery training (ST3–ST8). Successful completion of this pathway leads to the Certificate of Completion of Training (CCT) and entry into the General Medical Council's (GMC) specialist register [50]. The CCT indicates that a cardiothoracic surgeon is competent to practice in the UK as a consultant surgeon. All specialists are expected to maintain their professional development, according to Good Surgical Practice, for the purposes of recertification [17,50].[4]

6.3. Canada

After medical school, certification in cardiac and thoracic surgery is obtained through separate 6-year integrated residency programmes [51]. This includes 24 months of core surgery; 6 months of cardiac surgery; 6 months of senior residency training in cardiac surgery with minimum 3 months on a paediatric cardiac surgery rotation; 12 months of senior residency training in adult cardiac surgery; 12 months of senior residency in general surgery, vascular surgery or thoracic surgery; and 12 months of academic enrichment [52]. Alternatively, residents who have completed general surgical training may also apply for entry into either integrated programme [51]. Completion of postgraduate medical education must be certified by the programme director and the postgraduate office on a 'Confirmation of Completion of Training' (CCT) form [52]. Successful completion of this pathway and the Principles of Surgery Examination allows trainees to sit for the Royal College Certification Examination in Cardiac Surgery or Thoracic Surgery [52]. An additional 18 months of training is required for certification in both disciplines [51].

7. European certification

Cardiothoracic surgeons in Europe may additionally seek certification by the European Board of Thoracic and Cardiovascular Surgeons (EBTCS). Specialists, who have completed their training and possess a Completion of Specialist Training (CCST) or equivalent and have undertaken the necessary operative procedures, are eligible for examination.[5] Separate examinations can be undertaken in either Thoracic Surgery or Cardiovascular Surgery. Candidates are expected to possess in-depth knowledge on the selection, assessment, operative- as well as postoperative management of common cases in cardiothoracic surgery. This aims to set a unified standard of competence necessary of independent cardiothoracic surgery practice across Europe.

[4] Intercollegiate_Surgical_Curriculum_Programme. ISCP. https://www.isc-p.ac.uk/Syllabus/Overview.aspx?Spec=CT. 2010.

[5] EBTCS. Information for Candidates. In: Surgeons EBoTaC, editor. http://www.ebtcs.org/, 2009.

8. Recertification

The recertification is a professional regulation that aims to maintain excellence in patient care. It includes lifelong learning for clinicians, along with regular assessment of practice [17,33]. This section outlines the recertification process in the UK, Canada and the US.

8.1. United States

The ABTS is responsible for both primary certification as well as maintenance of certification. In January 2008, the ABTS replaced its recertification process with the ABMS Maintenance of Certification (ABMS MOC) [49]. Through ABMS MOC, a cardiothoracic surgeon demonstrates commitment to lifelong learning and competency by undergoing regular assessment in six core competencies: patient care, medical knowledge, practice-based learning, systems-based practice, professionalism and communication skills [31,49]. The recertification process focusses on CME (American Association for Thoracic Surgery and pharmaceutical and biomedical industries), operative review (most recent 100 consecutive major operative cases) and examination (Self-Education/Self Assessment in Thoracic Surgery, SESATS).

8.2. United Kingdom

Revalidation certifies that a cardiothoracic surgeon remains fit to practice with up-to-date knowledge and skills. The revalidation of a specialist involves relicensing and recertification [53]. All medical practitioners registered with the GMC are required to renew their licence annually through an annual appraisal with a trained appraiser. In addition, specialists need to meet standards of practice as determined by the Royal Colleges, following approval by the GMC [54]. This involves several components, including multisource feedback, audits, appraisals, incident reports as well as basic medical practice. This process provides a framework through which the National Health Service (NHS) regulates clinical practice, promoting a culture of quality, professional accountability and patient safety [17]. In the future, the aim is to closely couple continuing education with the recertification processes. The recertification process is aimed to commence in 2010 [17].

8.3. Canada

The maintenance of the certification programme was officially established in 2000. Fellows of the Royal College of Physicians and Surgeons of Canada must complete a minimum of 40 credits of CPD every year and a minimum of 400 credits each 5-year cycle [55]. The activities are divided into six sections, ranging from group learning activities, Internet CME courses, structured learning projects and personal practice review to personal-educational-development activities. This way, fellows may address areas of interest with activities that best suit their individual needs. Specialists, who successfully complete the programme, receive a certificate and their names are published on the college website.

9. Challenges and future recommendations

Implementation of the European Working Time Directive, new quality assurance targets and additional funding constraints have antagonised service and training priorities [56]. Achieving competency in one-fifth of the time of our predecessors 'requires either genius, intensive practice, or lower standards' [57]. The severe reductions in training opportunities challenge the traditional time-based, apprenticeship model of training. In a survey of trainees registered with the European Association of Cardio-thoracic Surgery, 96.2% believed that the current 48-h working week is insufficient for their training needs, 60.5% of trainees are dissatisfied with their overall training and only 37.8% of trainees undergo regular assessment of their progress [58]. A structured, validated, competency-based curriculum for the cardiothoracic surgeon needs to be developed.

Before implementing a competency-based framework, several critical questions need to addressed. Will the curriculum be truly beneficial for trainees? Will trainees be available in their daily, busy, service-orientated schedules? Should trainees complete all of this education within their clinical working hours or should this be an 'after hours' activity? Who should establish, validate, update and maintain the curriculum? What sources of funding will support this educational venture? Can a uniform curriculum and methodology for assessment be applied across all training programmes?

Transforming a competency framework in cardiothoracic surgery into tomorrow's reality is not the sole responsibility of the trainees but is equally the responsibility of our governing bodies and the government. Numerous reforms in the UK NHS have been driven by priorities antagonistic to the development of surgical trainees [57,59].

The Royal College of Surgeons of England emphasises that surgical training must be recognised as a priority [60]. Resources must be available to establish the curriculum, develop simulation programmes and set up skills' courses, and the loss of trainee—patient care hours need to be adequately compensated [44]. To maximise training opportunities, protected trainee surgical lists and clinics need to be introduced, with the senior trainees being afforded extensive supervisor-independent operating [57,61,62]. The current selection criteria for trainees entering surgery have also been challenged by the impetus of achieving surgical competence in a shortened time [63]. Limiting selection to trainees with specific inherent aptitudes and personality traits advantageous to attaining surgical competence has been proposed. However, competent and talented surgeons cannot be reproduced by superior performance on simulators alone. For this to occur, more research is needed on defining, identifying and assessing the components of competence and how it predicts future performance.

Previous attempts at introducing competency-based curricula have frequently been hampered by the unavailability of expert trainers. Supervision is essential to monitor skill development, assess performance and to provide feedback. Becoming a trainer should be a choice and not an obligation [57]. Currently working and retired consultants alike, with an interest in surgical education, should be encouraged to become trainers with appropriate levels of support, reward and compensation for lost service-provision hours [57,61].

To stand the test of time and to maintain adequate funding and support, a competency-based training curriculum and competency framework must be evidence-based and frequently audited to uphold the highest standards of excellence. Similarly, valid and consistent recertification practices incorporating simulation are needed to effectively assess both technical and non-technical skills to enable competent practice. Finally, a commitment to translational research, advancing scientific knowledge and refinement of therapeutic approaches will enhance the reputation of cardiac surgery and protect from bureaucratic over-regulation [21].

10. Conclusions

Competence entails proficiency in technical and non-technical skills. With reduced working hours, funding constraints and new quality assurance targets, the practice of cardiothoracic surgery faces a paradigm shift in training and assessment. There is a lack of valid educational tools in the field. Structured and competency-based training curricula, which demand the acquisition of a predefined benchmark of skill proficiency prior to progression, are needed (Fig. 1).

For trainees, simulation programmes may offer an opportunity for skills' development in an environment where training opportunities are limited and are dependent on patient availability. For the specialists, continuing professional development is essential to maintain knowledge and skills to enable competent practice. A valid and effective recertification process for cardiothoracic surgeons needs to be developed and successfully integrated into continuing medical education curricula.

Issues regarding lack of availability of trainees, trainers and funding need to be resolved before a competency-based framework for cardiothoracic surgery may become tomorrow's reality.

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