## Contents

**Foreword** ......................................................... 4  
**Executive summary** ........................................... 5  
**The specialty** ..................................................... 7  

### Adult cardiac surgery ........................................ 8  
- **Background** ................................................... 8  
- **Contemporary provision** .................................... 8  
- **Surgeons** ....................................................... 8  
- **Current practice** ............................................... 9  
  - **Overview**  
  - **The team**  
  - **Job plans**  
  - **On-call commitments**  
  - **Work-life balance**  
  - **Commitment to training**  
  - **Training requirements**  
- **The future of cardiac surgery** .............................. 11  

### Thoracic surgery .............................................. 12  
- **Background** ................................................... 12  
- **Current practice** ............................................... 12  
  - **Overview**  
  - **Job plans**  
  - **On-call commitments**  
  - **Commitment to training**  
  - **Training requirements**  
- **The future of thoracic surgery** ............................. 13  

### Mixed practice cardiothoracic surgery .................. 15  
- **Background** ................................................... 15  
- **Current practice** ............................................... 15  
  - **Overview**  
  - **Job plans**  
  - **On-call commitments**  
  - **Commitment to training**  
  - **Training requirements**  
- **The future of mixed practice cardiothoracic surgery** 16  

### Congenital cardiac surgery .................................. 17  
- **Background** ................................................... 17  
- **Current practice** ............................................... 18  
  - **Overview**  
  - **Changes in the current workforce**  
  - **Job plans**  
  - **Work-life balance**  
  - **Predicted changes in activity**  
- **Training in congenital cardiac surgery** .................. 24  
- **Total workforce calculation** ................................. 24  

### Cardiopulmonary transplantation .......................... 25  
- **Background** ................................................... 25  
- **Current practice** ............................................... 25  
  - **Overview**  
  - **Transplant surgeons**  
  - **Current standards**  
  - **On-call commitments**  
  - **Work-life balance**  
  - **Previous workforce evaluations**  
- **Summary** ....................................................... 30  

### Academic cardiothoracic surgery ........................ 31  
- **Background** ................................................... 31  
- **Current practice** ............................................... 31  
  - **Overview**  
  - **Job plans**  
  - **Work-life balance**  
  - **Training in academic cardiothoracic surgery**  
- **The future of academic cardiothoracic surgery** ........ 32  

### Training the future workforce .............................. 33  
- **Medical school recruitment** ............................... 33  
- **Curriculum** .................................................... 33  
- **National selection** .......................................... 33  
- **Sub-specialisation** .......................................... 33  
- **The specialist exam** ......................................... 33  
- **Peri-CCT fellowships** ...................................... 34  
- **Professional development** ................................. 34  

### Becoming a cardiothoracic surgeon ....................... 35  
- **Junior surgeons** ............................................. 35  
- **NTNs and national recruitment** ............................ 35  
  - **The application form**  
  - **The interview**  
  - **The ‘wash up’**  
- **ST1 entry portal** ............................................. 35  
- **Current training status** ...................................... 36  
- **Sub-specialty training** ....................................... 36  
- **Summary** ....................................................... 36  

### Cardiothoracic trauma ....................................... 37  
- **Background** ................................................... 37  
- **Standards** ..................................................... 37  
- **Limitation of standards** ..................................... 37  
- **Recent developments in cardiothoracic trauma care** 37  
- **Training** ......................................................... 37  
  - **Distribution of major trauma centres** ................. 37  
    - **Adult and children’s major trauma centres**  
    - **Adult major trauma centres**  
    - **Children’s major trauma centres**  
    - **Collaborative major trauma centres**  
- **Consultant job plans** ........................................ 38  
- **Outstanding issues** .......................................... 38  
- **Summary** ....................................................... 38  

### Contributors: .................................................. 39
Foreword

Health care continues to evolve at a remarkable pace. There are many factors that influence this evolution: medical advances, affordability, political priorities, general health of the population, pharmaceutical industry and public expectations.

These factors have led to major inequalities in health care around the world. The wealthy nations have developed expensive models of health care with some clear measures of success such as a major reduction in peri-natal mortality and increased life expectancy. This has produced a new dilemma as the population assesses the relative values of prolonged life and/or quality of life.

At a specialty level, there have been continuous advances driven by a desire to deliver better patient outcomes, professional and institutional competition, and pharmaceutical ambition/profit. Cardiothoracic surgery in the UK is no exception, with many advances, including a proven record delivering consistently high standards nationwide.

It is ten years since the specialty produced a workforce report. This contemporary publication is a reflection of the changes that have occurred in the specialty, how they affect the work of a cardiothoracic surgeon, and the implications for the medical workforce in terms of recruitment and training, both now and in the future.
Executive summary

Cardiothoracic surgery continues to be an evolving career with potentially varied practice; there are four major sub-specialties to practise in as a consultant in Great Britain and Ireland. This is an academically and technically challenging specialty, and there is evidence that it continues to attract some of the brightest and most able applicants into surgery.

The purpose of this document is to provide insight into workforce planning in the specialty for the future, particularly in respect to the four principal sub-specialties of adult cardiac surgery, thoracic surgery, congenital cardiac surgery and transplantation. It has been prepared from the joint perspective of the Society for Cardiothoracic Surgery in Great Britain and Ireland (SCTS) and the specialist advisory committee (SAC) for cardiothoracic surgery. It is a stocktake of both where the specialty is in terms of workforce and future challenges for workforce planning in the specialty.

This report coincides with Health Education England and the Centre for Workforce Intelligence taking a more active role in workforce planning. 2015 is the second year in which they have worked with the SAC to produce predictions (in conjunction with the other medical and surgical specialties) leading to a recommendation on the number of surgical trainees who should be entering into national training on an annual basis for cardiothoracic surgery.

This workforce document is a product of the SCTS and SAC working closely together, particularly in aspects of education and training, and more recently concerning the development and delivery of curriculum aligned courses for national trainees.

National selection has now been running for eight years and planning for the ninth year (2016 entry) is underway. In the last three years, in addition to entry at the ST3 level, entry at ST1 has become possible. This is likely to continue until the 2017 entry point, with a formal evaluation of its success or otherwise due to be reported in summer 2016.

Adult cardiac surgery

The volumes of surgical activity appear to be static, and there is a degree of equipoise between percutaneous coronary intervention and coronary artery surgery. The workforce is relatively stable but there is an increased need to develop specialist surgical services, for example in mitral valve surgery and aortovascular surgery.

Mechanical circulatory support is evolving and a workforce will be required to provide this service (when defined by the National Health Service [NHS]). There are already provisional efforts to develop and support a fellowship in this area. This fellowship would be completed either before or after receipt of the Certificate of Completion of Training (CCT) but typically before a trainee has started applying for consultant posts.

New techniques in minimally invasive cardiac surgery are being developed that will require peri/post-CCT training. This will be driven largely by local service needs.

Thoracic surgery

There is probably a need for a greater number of thoracic surgeons. The resection rate has been rising gradually over the last decade as detailed in the National Lung Cancer Audit but it will most likely achieve a natural ceiling in the next few years of around 20–25%. However, there is an increased demand for thoracic surgeons to attend multi-disciplinary team meetings (including off-site meetings) and this will be a driver for further appointments in this area of the specialty.

Video assisted thoracoscopic lobectomy is increasing year on year as a percentage of the total number of resections performed. Newly appointed thoracic surgical consultants will need to be experienced in this newer technique.

Mixed practice cardiothoracic surgery

The commissioning of cardiothoracic surgical services is in the process of changing. These changes may have an effect on both the provision and delivery of adult cardiac surgery and adult thoracic surgery such that mixed practice consultant cardiothoracic surgical posts may be difficult to sustain.

Congenital cardiac surgery

The consultant workforce in this sub-specialty is relatively stable and the number of required consultants can be predicted reasonably accurately because of the small size of this area of the specialty. It is likely to be around 1–2 new consultants per year. There is a national programme in peri-CCT training in congenital cardiac surgery. This was based previously at Great Ormond Street Hospital and Birmingham Children's Hospital but there are plans to expand the number of potential training centres.

There is an NHS-wide congenital cardiac surgery review (due to report in 2015) that is expected to make recommendations about the numbers of consultant surgeons and the numbers of cases that should be undertaken per centre. This is likely to have an impact in the long term on the number of congenital cardiac surgeons and their working patterns.

Cardiopulmonary transplantation

This sub-specialty has been difficult to staff because of demographic changes including the age/retirement of current surgeons. This has been partly addressed by the appointment of two peri-CCT fellowships designed to run over 18 months at Papworth Hospital in Cambridge and Freeman Hospital in Newcastle. A third fellowship appointment is expected to be made by the end of 2015. This will mean that there will be three senior trainees in post, which could potentially produce one cardiothoracic transplant surgeon approximately every 6–9 months over the next 3–5 years.

Shape of Training review

In October 2013, on behalf of the General Medical Council (GMC), Professor Greenaway published the Shape of Training review, which applies to all medicine and surgery. There is little in the review document that is absolutely specific to cardiothoracic surgery. However, the recommendations in the Shape of Training review seem to be moving against the direction of travel in the specialty of cardiothoracic surgery, where recent service consultant appointments have been made primarily in either cardiac surgery, thoracic surgery or congenital cardiac surgery. The ethos of the Shape of Training review is generally based around producing a workforce for a more generalist type of surgical role, which in other medical and surgical specialties is focused on the delivery of emergency care. In cardiothoracic surgery, the type of consultant appointments made will be dictated largely by local service needs.
Provision of service at the middle grade registrar level
Currently, middle grade rotas are staffed partly by trainees with a national training number (NTN) but also by trust doctors who do not hold an NTN, to make up the numbers to provide an on-call work pattern that is compliant with the European Working Time Regulations. This has increased the number of middle grade surgical staff who have a requirement for training. For non-NTN holders, there is a route on to the GMC specialist register via the Certificate of Eligibility for Specialist Registration (CESR) in cardiothoracic surgery. There is a relatively large number of middle grade doctors who are competing for operative surgical training as a result.

Higher surgical training
The standard of the current CCT should be maintained. However, owing to the evolving technical aspect of the cardiothoracic surgery, the number of peri- and post-CCT fellowships are expected to increase alongside specialisation.

The SCTS is developing a series of fellowships in partnership with industry. The nature of these fellowships and the development of sub-specialisation are likely to lead to the consideration of credentialling, which the GMC may devolve to professional specialty associations and SACs.

Seven-day working
The recent drive to achieve seven-day working in the NHS and the potential for a new consultant contract to be implemented as a result of this may have an effect on future consultant cardiothoracic surgical working patterns. The consequences of seven-day working are currently unknown and clarity is required from the government as to what is expected for the whole of the specialty of cardiothoracic surgery. This may impact on the need to appoint increased numbers of consultants in the future.

Outcomes
Patient outcomes from the sub-specialty clinical surgical audits will need to be borne in mind as current and future consultant surgeons consider their potential activity in adult cardiac and adult thoracic surgery. It will be challenging for consultants to continue in mixed consultant cardiothoracic surgical posts as consultant job planning and commissioning of services continues to evolve. In addition, higher surgical trainees in the specialty are tending to specialise in one aspect of either adult cardiac surgical or thoracic surgical practice at the time of their CCT. This is again in part being driven by local service needs.

There is concern that the monitoring of surgical outcomes at both unit and consultant level is potentially affecting the number and complexity of operative surgical cases being delegated to higher surgical trainees. The SAC will be watching this closely. The development of peri- and post-CCT fellowships is a potential solution to increase surgical case numbers and the possible complexity of cases for higher surgical trainees. The SAC is currently working to define indicative case numbers to achieve the CCT. It also needs to define what a surgical case is in terms of being counted towards those indicative numbers.

Evidence has been collected in cardiothoracic surgery over the last 5–6 years that more than 5% of the consultant cardiac surgical workforce has been ‘in difficulty’. In almost all cases, this has been due to a failure of professionalism and teamworking within units. On occasion, it has led to degrees of restriction in surgical practice. The SCTS and SAC recognise this issue and will strive to deliver a ‘professionalism’ agenda over the next few years to address this potential problem for newly appointed and current consultant cardiothoracic surgeons.
The specialty

Cardiothoracic surgery includes adult cardiac surgery, adult thoracic surgery, mixed practice cardiothoracic surgery, congenital cardiac surgery, thoracic transplantation and circulatory support. There are also surgeons with a significant academic role.

The vast majority of the surgery involves major interventions with significant risks for the patients but also offering significant benefits concerning quality and prolongation of life. The surgery is highly skilled and the surgeon bears the huge responsibility for patient outcome. These outcomes are wholly dependent on sufficient resource, not only with regard to the physical establishment but also in terms of a well trained, coherent and functioning multi-disciplinary team. The role of the anaesthetist cannot be underestimated in the pre-operative assessment, peri-operative monitoring and post-operative care.

Thoracic surgery developed with the treatment of tuberculosis and also oesophageal conditions, with patients often located in tuberculosis sanatoria. These surgeons and teams were ideally placed to learn the new techniques for cardiac surgery, including the development of cardiopulmonary bypass in the 1960s. The UK therefore had a model of mixed practice cardiothoracic surgery: thoracic, cardiac and paediatric.

With the introduction of effective immune suppression, intra-thoracic transplantation became more widespread in the 1980s and it was these units that became more involved with mechanical circulatory support.

In the last decade, the specialty has seen two significant changes. First, there has been the introduction of multi-disciplinary team meetings in care pathways for lung cancer and for coronary revascularisation. More recently, multi-disciplinary teams have been introduced for transcatheter aortic valve implantation and mitral valve surgery. Second, the specialty has seen the introduction of more sub-specialist procedures such as minimal access surgery for lung resection, mitral valve surgery and major aortic surgery. These two changes, combined with the increased knowledge base required for the sub-specialties, have made a mixed cardiac and thoracic surgical practice less sustainable. Congenital and paediatric cardiac surgery has already become independent from acquired adult surgery.

This report will document the current status of the workforce in each of the sub-specialties in cardiothoracic surgery as well as trying to predict future trends.
Adult cardiac surgery

Background

Surgery on the heart was rare until the latter part of the 20th century. In the late 19th century, there had been occasional successes with penetrating trauma and in the 1920s the first closed mitral valvotomies were performed for mitral valve stenosis. It was the development of more reliable cardiopulmonary bypass in the 1960s that unleashed the ‘mass production’ of cardiac surgery in the modern era.

At first, adult cardiac surgery focused on acquired valve disease and congenital defects. The ability to define coronary anatomy with cardiac catheterisation then led to an explosion of revascularisation in the 1970s, initially using the saphenous vein and then also the left internal thoracic artery, which was used from the 1980s.

Now, in the 21st century, around 50% of cardiac surgery in the UK consists of urgent revascularisation (coronary artery bypass surgery) for acute coronary syndromes. 15% of cardiac surgery is elective coronary artery bypass grafting to relieve stable angina or for prognostic benefit. 15–20% is attributed to aortic valve surgery, becoming more common in the ageing population owing to degenerative disease often in association with ischaemic heart disease. The remainder of cardiac surgery involves the mitral valve and major aortic surgery.

In the UK, all adult cardiac surgery activity has been registered since 1978. This process has become more and more defined, and since 2005 mortality rates have been published by operation, surgeon and unit adjusted for the pre-operative status of the patient and the complexity of the surgery.

The NHS has invested heavily in the treatment of heart disease. In the early 1990s, it was evident that the provision was well behind Europe and the US. With the backing of a National Service Framework, new cardiac surgical centres were created around England and Wales, coupled with standards set by the National Institute for Health and Care Excellence. This investment was associated with a significant increase in activity and workforce.

Contemporary provision

Overall activity has remained consistent at around 30,000 operations per annum for several years despite the expansion of percutaneous coronary intervention and trans-catheter aortic valve implantation. The throughput per unit ranges from 500 to approximately 1,750 cases per annum with a mean of 890 cases (Figure 1). There are 8 centres that do more than 1,000 cases per annum. The number of units across the individual regions of the UK and Republic of Ireland is shown in Table 1.

Table 1
Adult cardiac units across the UK and Republic of Ireland

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of units:</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>30</td>
</tr>
<tr>
<td>Wales</td>
<td>2</td>
</tr>
<tr>
<td>Scotland</td>
<td>3</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>1</td>
</tr>
<tr>
<td>Ireland</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>

Surgeons

Based on the published outcomes for cardiac surgery in 2010–2013 (SCTS website), there are 263 surgeons practising adult cardiac surgery in the UK. The mean number of cases operated on per annum was 119, with a mode of 141 (Figure 2). This includes data for adult congenital cardiac surgeons, mixed practice surgeons, surgeons in their first years and surgeons near retiring.

Figure 1
Adult cardiac cases per centre per annum (range: 500–1,749, mean: 890, mode: 640, median: 828)
The age distribution of adult cardiac surgeons is fairly uniform although there is a larger cohort aged 45–49 years (Figure 3), which may have implications for recruitment around 2030.

There are very few women in adult cardiac surgery (<5) although there are significantly more women now training in cardiac surgery.

Current practice

Overview

Cardiac surgery is extremely intense work. Perhaps this is well accepted but at the same time it may also be taken for granted. In each and every case, the surgeon bears the responsibility for delivering a successful outcome to the patient. The margins of error are narrow, and they are even finer for the older and sicker patients. The operations are long and demanding, calling for significant mental and physical stamina. The surgeon requires the inner confidence to perform the surgery but also the ability to reflect on his or her actions and decisions.

The team

The patient undergoing cardiac surgery is dependent on a large team where the consultant surgeon may often be perceived as the leader. Other key team members include:

The cardiologist: Following investigations, the cardiologist will discuss the options with the patient, and a decision will be made on whether to consider cardiac surgery and make a referral for surgical opinion.

The anaesthetist: There is close co-operation in cardiac surgery with the anaesthetist at many stages of the patient’s journey: pre-operative assessment, peri-operative support and assessment with transoesophageal echocardiography, and post-operative intensive care.

The perfusionist: Perfusionists are skilled clinical scientists who maintain the patient during cardiopulmonary bypass, communicating closely with the surgeon and anaesthetist.

The scrub team: The scrub team provides vital support during the procedure, and ensures multiple items of equipment are prepared and ready for the case.

Advanced nurse practitioners / nurse practitioners / surgical care practitioners / specialist nurses and allied health practitioners: These team members offer invaluable support for patients and their continued care through the inpatient journey. Prior to surgery, they provide physical, psychological and social aspects of care as well as offering detailed information. They are responsible for the admission of patients and the accuracy of clinical assessment. They assist the consultant surgeon in theatre and perform some aspects of the operation under supervision. Alongside the medical team, they are responsible for managing patients post-operatively prior to discharge.
The outpatient department: This is often the first point of contact for a patient. Here patients will attend both surgical appointments and pre-assessment clinics prior to their surgery. Outpatient departments are run by cardiothoracic nursing staff but specialist nurses and allied health practitioners (as listed above) work here also.

The ward: Staff on the ward are fundamental to ensuring that patients are prepared correctly for theatre and also for their continued care after leaving the intensive care unit. Length of stay is usually between 5 and 7 days but this can be longer because there are often difficulties when repatriating patients home or to their referring hospital. On the ward, there are also many allied health practitioners (such as physiotherapists, occupational therapists, and pharmacists) who provide care for the patients during their stay.

The intensive care unit: This is a critical area in determining the quality of patient outcome after the operation has been completed. Prompt appropriate action is needed to prevent patients deteriorating irreversibly.

The administrative support: This is the ‘shop window’ of the service. The secretaries deal with the patients pre- and post-operatively, ensuring their concerns are answered. They ensure good communication with general practitioners and cardiologists. They also free up time for the surgeons to allow them to maximise their clinical workload.

The audit team: Modern medicine requires accurate measures of activity and outcomes. An audit team that understands cardiac surgery and works closely with the surgical team is vital to produce accurate, meaningful data.

The hospital/trust: All parts of the cardiac surgical team listed above are dependent on a functioning organisation. This delivers the structure in terms of physical buildings, maintenance, equipment and human resources. It will also support the strategy and development of the department to meet the needs of patients, the organisation itself and the other services within it.

Job plans
In broad terms, a job plan of 10 programmed activities (PAs) per week will deliver all the clinical work to enable 1.5 days of operating over a 42-week year. (This allows for annual leave and study leave.) A job plan of 12 PAs would deliver 2 days of operating.

In equally broad terms, if there were no cases cancelled/bank holidays etc, this would deliver around 126 cases per annum with 10 PAs and 168 per annum with 12 PAs. However, the complexity of surgery, the impact of emergencies and the cancellation of theatre sessions due to resource limitations generally result in less delivery.

The days in theatre are usually extended, starting early and finishing late, so these are allocated 2.5 or 3 sessions. The job plan will need at least one session in the outpatient clinic and one or two sessions in multi-disciplinary team meetings. The surgeon will review his or her patients regularly (once or twice a day) as well as giving opinions for in-house referrals. Other sessions will be allocated for audit, participation in management and continued education.

On-call commitments
This has changed considerably in some units. Cardiac surgeons used to be responsible around the clock for their patients on the intensive care unit and the ward. They were regularly contacted about their patients and on operating days they would be responsible for intensive care unit management as well as potential complications such as reoperations for bleeding. The trend now is for the multi-disciplinary team to take more responsibility, with the on-call intensivist taking shared responsibility for the intensive care unit stay and, in some units, surgical colleagues sharing out-of-hours care for the patients.

There are very few true cardiac surgical emergencies. Trauma is rare, leaving acute aortic syndromes as the main emergencies requiring immediate surgery. Most acquired conditions such as ventricular septal defect or ruptured mitral valve apparatus can wait until ‘daylight’ hours. There are many more referrals for urgent surgery (30–50% of all cases) and these patients need a consultant opinion.

On-call arrangements still retain their ‘category A’ status in the NHS contract as the surgeon is needed immediately in a significant number of situations.

Work–life balance
This has improved considerably over the last three decades. A surgeon can therefore expect to be on call at a frequency dependent on the size of the team: every fourth to seventh night and weekend. On non-operating days, the start and finish times are fairly predictable, enabling a commitment to responsibilities at home. The finish times on operating days are unpredictable, with the subsequent impact on home life. On-call duties are not frequent but emergency operations will take several hours to complete and will need a recovery period if a night’s sleep has been disturbed.

Commitment to training
Why has this changed so much?

Twenty years ago the consultant surgeon would be supported by a team of at least two doctors/surgeons: senior registrar, registrar and senior house officer. These doctors looked after the inpatients, and in theatre they would be responsible for opening and closing the patient. The senior registrars were often independent operators, able to do whole cases and lists unsupervised. They were not trained as such but, if they demonstrated competence, they were allowed to progress. The consultant would tend to train the senior registrar, who in turn trained the registrar, who then trained the senior house officer.

Nowadays, the consultant surgeon may have one doctor/surgeon directly supporting his or her practice. This doctor can be very junior and inexperienced. Modern cardiac surgeons therefore have a much larger commitment in theatre for the progress of the entire case. At the start, they are present for the World Health Organization safety checklist and often also for opening/cannulating and ensuring good conduit is harvested. They will frequently stay to completion of the case to ensure haemostasis and chest closure is satisfactory.
As far as we can tell there will still be a need for adult cardiac surgery for the next ten to twenty years at least. New techniques to treat heart disease such as PCI and TAVI have a major significant role for patient care, but so far have not had a major impact on the amount of cardiac surgery performed in the UK. Newer cardiology techniques may be developed to reduce the need for traditional cardiac surgery but that does not appear imminent and in many cases the surgeon will be involved in the newer procedure.

The developments in cardiology have prompted change in the specialty. The efficacy of minimal access mitral surgery is being assessed as well as minimal access aortic valve surgery. Off pump coronary bypass surgery is being performed by more surgeons with excellent results and vein harvesting is being done endoscopically. All of these techniques require extra training and extra skills – they are not easy procedures and few surgeons are able to master all of them. Therefore, the current trend is for surgeons to sub specialise as well as keeping their core skills in coronary bypass grafting and aortic valve replacement.

Most importantly there will be a significant change in the structure of our work environment. ‘In the beginning’ the surgeon was independent performing their own practice, to the point they were almost competing with their colleagues. Now the surgeon needs to be a team player and where appropriate is still best placed to lead that team. They will have to consider the needs of the service and the patients before they think of their own needs. There will be more shared care so they will often be looking after their colleagues’ patients and vice versa. This will require mutual trust and respect within the multi disciplinary team and will require significant time and commitment to build and maintain those relationships for the sake of patient care.

In terms of recruitment to maintain a steady state it would appear that around 10 adult surgeons will be required per annum, and between 2025 and 2030 the need will be 15 surgeons per annum. This does not allow for the potential expansion or contraction of the demand for adult cardiac surgery.
Thoracic surgery

Background

Thoracic surgery became a separate specialty from the generality of surgery around 100 years ago owing to the development of surgical treatments for tuberculosis. The problems of operating within the thoracic cavity were solved by the invention of endotracheal intubation and artificial ventilation, and this allowed all non-cardiac intra-thoracic diseases to be targeted for therapy by surgeons.

The Second World War led to a huge leap forward in all medical technologies, and the availability soon afterwards of antibiotics and blood transfusion allowed chest injuries to be dealt with routinely. Although antibiotics and public health measures significantly reduced the need for surgery for tuberculosis, thoracic surgeons soon found that with improvements in peri- and post-operative surgical care, many more patients could benefit from operations. This particularly included the development of the sub-speciality of cardiac surgery. Perhaps most of all throughout the 20th century there was an epidemic of smoking related diseases such as lung cancer, which now affects 40,000 patients in the UK every year.

Oesophageal surgery was developed jointly between thoracic and general surgery throughout the latter half of the 20th century. For a number of reasons (the development of local endoscopy services, medical treatment of peptic ulcers and gastro-oesophageal reflux, the explosion of cardiac surgery throughout the 1980s and 1990s to the detriment of general thoracic surgery), oesophageal surgery in the UK is now managed within the newer sub-specialty of upper gastrointestinal surgery and is rarely carried out by thoracic surgeons.

Current practice

Overview

Thoracic surgery is a very varied specialty in terms of the range of diseases managed and the age and infirmity of the patients seen. Although many patients are referred from colleagues in respiratory medicine, thoracic surgeons receive requests for advice about surgery from all hospital consultants as well as occasionally directly from general practitioners. There is a significant commitment to outpatient work; many patients are seen for an opinion in the outpatient department but do not require operative surgery.

Owing to the frequency of the disease and its complexity, lung cancer multi-disciplinary teams (for which thoracic surgeons are core members) are required in all hospitals. In most parts of the country, thoracic surgeons travel to other hospitals for these meetings as well as providing an outpatient service. In addition to their lung cancer work, thoracic surgeons are required to attend other multi-disciplinary team meetings such as for teams managing emphysema, interstitial lung disease and thoracic sarcomas.

Thoracic operations range from those that can be performed within a few minutes as day cases to major procedures that take several hours and for which patients require several days (if not several weeks) of inpatient care afterwards. As in cardiac surgery, this requires a close working relationship with all members of the team including the anaesthetist, intensive care nurses and specialist nurses. After surgery, thoracic patients are often managed on high dependency units, which are usually staffed by surgeons as an adjunct to the thoracic ward.

Owing to the major commitment of thoracic surgeons to the treatment of thoracic malignancies, they often need to monitor patients for several years after their surgery. These varied patterns of work and the relatively small number of patients to be looked after at any one time make for a stimulating career where there are real opportunities for offering a personal service to patients over many years and interacting with the whole medical profession.

Job plan

As a result of the variation in practice described above, thoracic surgical job plans are very variable also. Typically, for a contract with 10 PAs, there will be 1 whole day of operative surgery, 1–2 clinics and 1–2 multi-disciplinary team meetings per week.

Owing to the major commitment to lung cancer and other urgent conditions, there is a need for trusts to ensure flexible cover of theatre and multi-disciplinary team work for covering colleagues’ leave. It is therefore common for consultants to have job plans with 12 PAs, which mean up to 2 full days per week in theatre as well as their other duties.

On-call commitments

Except for the requirement for managing patients after thoracic surgery (which is run increasingly by teams rather than individual surgeons, as in cardiac surgery), on-call duties are not usually onerous although there is a requirement for thoracic surgeons to be available for advice and, occasionally, operative surgery around the clock. There is a major thoracic surgical commitment to working with respiratory physicians in the management of respiratory emergencies such as pneumothorax and empyema. Apart from trauma and airway interventions, virtually all emergency cases can be managed as urgent procedures on the next available list.

Thoracic surgeons generally work in small teams with the result that on-call commitments are relatively frequent, 1:3 and 1:4 rots being the norm. This has the potential to interfere with surgeons’ work–life balance. However, in practice, owing to the rarity of the need to attend hospitals immediately, this is not a major concern and life on call as a thoracic surgeon is currently less intrusive than for many other acute specialties.

Commitment to training

Compared with cardiac surgery, operative training in thoracic surgery is easier. The number of simple procedures in the specialty makes it possible for even junior trainees to accrue a significant caseload in only a few months. It is easy to separate the parts of the more major operations into sections for training, with minimal impact on theatre time constraints. The widespread use of video assisted thoracoscopic surgery (VATS) makes it possible for the trainer to see the same operative image as the trainee.

In contrast with coronary surgery, there are very few situations where a trainee can be allowed to be the lead surgeon as a significant technical error may occur that cannot be prevented.
by the attending consultant trainer. Furthermore, unlike cardiac surgery, only a single assistant is needed for thoracic operations so the reduction in the support for consultant surgeons over the last 20–30 years has led to much less of an impact on training. Training in multi-disciplinary team meetings and outpatient clinics (where in some ways the true skill of a thoracic surgeon is demonstrated in advising patients whether they should undergo surgery) is equally rewarding, and is a stimulating place for trainees to work.

**Training requirements**

As in cardiac surgery, trainees are required to spend ten years in postgraduate training for certification in the UK to work as a thoracic surgeon. As newly appointed consultants, they will be required to operate independently in all forms of elective and emergency thoracic surgery. VATS is a requirement in modern thoracic surgical practice and hospitals will increasingly expect trainees to have advanced VATS skills for procedures such as anatomical lung resections. However, as a result of an overall unmet need for thoracic surgery in the UK, the requirement for sub-speciality skills is less of an issue for thoracic surgeons.

It is likely that the training and assessment of completion of training of thoracic and cardiac surgeons will separate at some stage in the next few years, with ‘core’ cardiothoracic training for the first two years of entry into the specialty (ST3–4) followed by specialist training in either cardiac or thoracic surgery during years ST5–8.

**Recent developments**

Over the last 10–20 years, thoracic surgery has emerged as a separate sub-speciality within the wider practice of cardiothoracic surgery. Owing to a number of developments, particularly the introduction of the *NHS Cancer Plan* in 1998 and the appointment of general thoracic surgeons (as opposed to mixed practice surgeons), there has been what can best be described as an explosion in the volume of work carried out within the specialty.

The number of therapeutic lung cancer resections has doubled between 2005 and 2012, with a significant improvement in the survival of patients with the disease overall. Minimal access procedures are expanding and, in combination with oncological services, more patients with thoracic malignancies are being actively treated. As well as those with cancers, patients suffering from diseases that were until recently neglected by the specialty of cardiothoracic surgery (because of the ‘demands’ of the apparently more glamorous and financially lucrative cardiac side of the profession) are now getting better treatment. Nevertheless, access to thoracic surgery is still very varied throughout the country and there is much more that could be done.

**The future of thoracic surgery**

Owing to its variety and the current unmet need for thoracic surgery in the UK (especially in the treatment of lung cancer), it is extremely likely that thoracic surgery will continue to expand as a service over the foreseeable future. Although other modalities are emerging for the treatment of all thoracic malignancies, these services are expected to complement rather than compete with thoracic surgery in the management of patients. The following services will continue to evolve and add to the varied spectrum of thoracic surgery:

- minimally invasive surgery including VATS for lung resection, mediastinal surgery and correction of pectus excavatum/carina tum
- robotic surgery
- endobronchial treatments for emphysema
- endoscopic and operative airway interventions
- rib fixation in chest trauma
- targeted treatments in lung cancer

There will be increasing research opportunities associated with these advances.

As cardiac and thoracic surgical services separate completely, it may be that the numbers of centres providing thoracic surgery in the UK will reduce slightly to ensure sufficient surgeons are available to staff the on-call rotas as well as providing sub-specialty expertise as these services develop. The rate-limiting step in all these developments will be the availability of appropriately trained thoracic surgeons.

**Data**

The following tables contain data collected from the SCTS consultant database (2011–2012 Thoracic Surgical Register) and the *Improving Lung Cancer Outcomes* Project, which was for lung cancer resections carried out in 2012.

<table>
<thead>
<tr>
<th>Number of units</th>
<th>Thoracic surgery only</th>
<th>Shared with cardiac surgery</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>7</td>
<td>22</td>
<td>29</td>
</tr>
<tr>
<td>Wales</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Scotland</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>N Ireland</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rep Ireland</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of surgeons</th>
<th>General thoracic surgery</th>
<th>Cardiothoracic surgery</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>78</td>
<td>75</td>
<td>153</td>
</tr>
<tr>
<td>Wales</td>
<td>47 (35-62)</td>
<td>49 (38-67)</td>
<td></td>
</tr>
<tr>
<td>Scotland</td>
<td>52 (45-57)</td>
<td>58.5 (56-61)</td>
<td></td>
</tr>
<tr>
<td>N Ireland</td>
<td>19</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Rep Ireland</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>England</th>
<th>Wales</th>
<th>Scotland</th>
<th>N Ireland</th>
<th>Rep Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Thoracic Surgeons</td>
<td>68</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>% total</td>
<td>60.2</td>
<td>60</td>
<td>25</td>
<td>28.6</td>
</tr>
<tr>
<td>Median Age</td>
<td>47 (35-62)</td>
<td>54 (42-57)</td>
<td>52 (45-57)</td>
<td>58.5 (56-61)</td>
</tr>
<tr>
<td>Number ≥55</td>
<td>19</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of CT Surgeons</th>
<th>45</th>
<th>2</th>
<th>9</th>
<th>5</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Age (range)</td>
<td>49 (42-67)</td>
<td>49 (49-49)</td>
<td>52 (48-61)</td>
<td>45 (39-55)</td>
<td>48.5 (38-65)</td>
</tr>
<tr>
<td>Number ≥55</td>
<td>9</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Country</td>
<td>Unit (by city)</td>
<td>Total thoracic procedures</td>
<td>Major procedures</td>
<td>Intermediate procedures</td>
<td>Minor procedures</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>England</td>
<td>Basildon</td>
<td>424</td>
<td>265</td>
<td>140</td>
<td>19</td>
</tr>
<tr>
<td>Birmingham</td>
<td>1,278</td>
<td>804</td>
<td>266</td>
<td>208</td>
<td>104</td>
</tr>
<tr>
<td>Blackpool</td>
<td>523</td>
<td>341</td>
<td>74</td>
<td>108</td>
<td>131</td>
</tr>
<tr>
<td>Bristol</td>
<td>910</td>
<td>639</td>
<td>194</td>
<td>77</td>
<td>62</td>
</tr>
<tr>
<td>Coventry</td>
<td>479</td>
<td>287</td>
<td>51</td>
<td>141</td>
<td>62</td>
</tr>
<tr>
<td>Exeter</td>
<td>324</td>
<td>122</td>
<td>117</td>
<td>85</td>
<td>43</td>
</tr>
<tr>
<td>Hull</td>
<td>753</td>
<td>484</td>
<td>121</td>
<td>148</td>
<td>170</td>
</tr>
<tr>
<td>Leeds</td>
<td>1,435</td>
<td>762</td>
<td>338</td>
<td>335</td>
<td>298</td>
</tr>
<tr>
<td>Leicester</td>
<td>841</td>
<td>544</td>
<td>165</td>
<td>132</td>
<td>195</td>
</tr>
<tr>
<td>Liverpool</td>
<td>1,075</td>
<td>759</td>
<td>215</td>
<td>101</td>
<td>431</td>
</tr>
<tr>
<td>London – Barts</td>
<td>473</td>
<td>295</td>
<td>139</td>
<td>39</td>
<td>112</td>
</tr>
<tr>
<td>London – Brompton / Harefield</td>
<td>2,008</td>
<td>1,111</td>
<td>449</td>
<td>448</td>
<td>316</td>
</tr>
<tr>
<td>London – Guy’s / St Thomas’</td>
<td>1,449</td>
<td>925</td>
<td>417</td>
<td>107</td>
<td>364</td>
</tr>
<tr>
<td>London – Imperial</td>
<td>549</td>
<td>356</td>
<td>152</td>
<td>41</td>
<td>62</td>
</tr>
<tr>
<td>London – King’s</td>
<td>241</td>
<td>152</td>
<td>58</td>
<td>31</td>
<td>0</td>
</tr>
<tr>
<td>London – St George’s</td>
<td>995</td>
<td>426</td>
<td>395</td>
<td>174</td>
<td>149</td>
</tr>
<tr>
<td>London – UCL</td>
<td>701</td>
<td>513</td>
<td>151</td>
<td>37</td>
<td>120</td>
</tr>
<tr>
<td>Manchester</td>
<td>1,274</td>
<td>782</td>
<td>295</td>
<td>197</td>
<td>334</td>
</tr>
<tr>
<td>Middlesbrough</td>
<td>387</td>
<td>283</td>
<td>58</td>
<td>46</td>
<td>120</td>
</tr>
<tr>
<td>Newcastle</td>
<td>1,015</td>
<td>558</td>
<td>303</td>
<td>154</td>
<td>266</td>
</tr>
<tr>
<td>Norwich</td>
<td>531</td>
<td>344</td>
<td>138</td>
<td>49</td>
<td>103</td>
</tr>
<tr>
<td>Nottingham</td>
<td>902</td>
<td>743</td>
<td>147</td>
<td>12</td>
<td>258</td>
</tr>
<tr>
<td>Oxford</td>
<td>539</td>
<td>343</td>
<td>113</td>
<td>83</td>
<td>86</td>
</tr>
<tr>
<td>Papworth (Cambridge)</td>
<td>501</td>
<td>375</td>
<td>73</td>
<td>53</td>
<td>127</td>
</tr>
<tr>
<td>Plymouth</td>
<td>788</td>
<td>327</td>
<td>190</td>
<td>271</td>
<td>91</td>
</tr>
<tr>
<td>Sheffield</td>
<td>698</td>
<td>481</td>
<td>175</td>
<td>42</td>
<td>214</td>
</tr>
<tr>
<td>Southampton</td>
<td>892</td>
<td>569</td>
<td>239</td>
<td>84</td>
<td>194</td>
</tr>
<tr>
<td>Stoke-on-Trent</td>
<td>657</td>
<td>431</td>
<td>178</td>
<td>48</td>
<td>112</td>
</tr>
<tr>
<td>Wolverhampton</td>
<td>505</td>
<td>264</td>
<td>111</td>
<td>130</td>
<td>101</td>
</tr>
<tr>
<td>Wales</td>
<td>Cardiff</td>
<td>398</td>
<td>269</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>Swansea</td>
<td>253</td>
<td>148</td>
<td>68</td>
<td>37</td>
<td>65</td>
</tr>
<tr>
<td>Scotland</td>
<td>Aberdeen</td>
<td>206</td>
<td>154</td>
<td>38</td>
<td>14</td>
</tr>
<tr>
<td>Edinburgh</td>
<td>821</td>
<td>468</td>
<td>38</td>
<td>315</td>
<td>153</td>
</tr>
<tr>
<td>Glasgow – Jubilee</td>
<td>1146</td>
<td>792</td>
<td>281</td>
<td>73</td>
<td>342</td>
</tr>
<tr>
<td>N Ireland</td>
<td>Belfast</td>
<td>547</td>
<td>377</td>
<td>102</td>
<td>68</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>Cork</td>
<td>No data for 2011-12</td>
<td>No data for 2011-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dublin – St Vincent’s</td>
<td>245</td>
<td>167</td>
<td>39</td>
<td>39</td>
<td>47</td>
</tr>
<tr>
<td>Dublin – Mater Misericordiae</td>
<td>450</td>
<td>325</td>
<td>125</td>
<td>0</td>
<td>199</td>
</tr>
<tr>
<td>Galway</td>
<td>110</td>
<td>85</td>
<td>22</td>
<td>3</td>
<td>42</td>
</tr>
</tbody>
</table>
Mixed practice cardiothoracic surgery

Background

The current role of the mixed practice surgeon is the subject of considerable debate. Training has historically been in both disciplines but, with the advent of job planning, restrictions on contracted hours, multi-disciplinary team work and sub-specialty techniques, it is difficult for a new trainee to achieve the required competency in both disciplines. However, there remain a number of mixed practice units and mixed practice surgeons. This is a commentary about the current practice in the UK and Republic of Ireland with an opinion about the future trends.

Table 2 lists the units in the UK and Republic of Ireland where mixed practice cardiothoracic surgery is performed by all the surgeons whereas Table 3 lists those where it is performed by some of the surgeons. The remaining centres are either single specialty or have cardiac and thoracic surgeons.

Table 2
Units where cardiothoracic surgery is performed by all of the surgeons

<table>
<thead>
<tr>
<th>England and Wales:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolverhampton</td>
<td></td>
</tr>
<tr>
<td>Basildon</td>
<td></td>
</tr>
<tr>
<td>Hull</td>
<td></td>
</tr>
<tr>
<td>Republic of Ireland:</td>
<td></td>
</tr>
<tr>
<td>Galway</td>
<td></td>
</tr>
<tr>
<td>Cork</td>
<td></td>
</tr>
</tbody>
</table>

Table 3
Units where cardiothoracic surgery is performed by some of the surgeons

<table>
<thead>
<tr>
<th>England and Wales:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackpool</td>
</tr>
<tr>
<td>Cardiff</td>
</tr>
<tr>
<td>Coventry</td>
</tr>
<tr>
<td>Liverpool</td>
</tr>
<tr>
<td>London – Barts</td>
</tr>
<tr>
<td>London – Imperial</td>
</tr>
<tr>
<td>London – St George’s</td>
</tr>
<tr>
<td>London – University College</td>
</tr>
<tr>
<td>Newcastle</td>
</tr>
<tr>
<td>Oxford</td>
</tr>
<tr>
<td>Plymouth</td>
</tr>
<tr>
<td>Sheffield</td>
</tr>
<tr>
<td>Stoke-on-Trent</td>
</tr>
<tr>
<td>Swansea</td>
</tr>
<tr>
<td>Scotland:</td>
</tr>
<tr>
<td>Edinburgh</td>
</tr>
<tr>
<td>Glasgow</td>
</tr>
<tr>
<td>Aberdeen</td>
</tr>
<tr>
<td>Republic of Ireland:</td>
</tr>
<tr>
<td>Belfast</td>
</tr>
<tr>
<td>Dublin</td>
</tr>
</tbody>
</table>

Current practice

Overview

From the data presented in the thoracic section, in the UK and Republic of Ireland, there are 78 general thoracic and 75 mixed practice cardiothoracic surgeons. The respective numbers for the UK provinces are 68 and 45 for England, 3 and 2 for Wales, 3 and 9 for Scotland, 2 and 5 for Northern Ireland, and 2 and 14 for the Republic of Ireland.

Cardiothoracic surgeons need to ensure that the two specialties within their overall practice are managed effectively and that one group of patients is not disadvantaged by the requirements of the other. Surgeons practising cardiothoracic surgery usually cover one lung cancer multi-disciplinary team meeting and one peripheral clinic per week in addition to duties at their base hospital. Their clinics may be mixed practice as well, or for cardiac or thoracic patients only, depending on the overall organisation of the surgical unit where they are based.

Prioritisation of theatre duties is the most challenging issue for cardiothoracic surgeons. Owing to the longer time required for cardiac operations, the majority of cardiothoracic surgeons devote less than 50% of their overall operating time to thoracic surgery (recent SCTS survey). When the results of primary lung cancer resections are viewed on the SCTS database, it is clear that some centres perform a large number of resections but there is also a long ‘tail’ where a considerable number of surgeons perform very few resections. This is only part of the story as there is more to thoracic surgery than resections for lung cancer. Cardiothoracic surgeons provide an essential role in performing lung biopsies, pneumothorax surgery, pleural biopsy etc. However, these data have not been looked at in detail.

Job plans

As can be seen from the sections on cardiac and thoracic surgery, the work is intense and cardiothoracic surgeons have to strike a balance between the two very different disciplines. Most job plans would include at least two full days of operating, one thoracic multi-disciplinary team meeting, one cardiac multi-disciplinary team meeting and a mixed outpatient clinic. The majority of mixed practice surgeons work alongside single specialty thoracic and cardiac surgeons. As a result, they tend to focus on some specialist aspect of their work. There are very few units in England, Wales and Northern Ireland where cardiothoracic surgeons are expected to do everything. In Scotland and the Republic of Ireland, some units still have cardiothoracic surgeons providing all the services with some specialised services (e.g. transplantation) performed at the designated national provider. It remains to be seen how these services will be reconfigured over the next decade.

On-call commitments

Mixed practice surgeons have to cover both thoracic and cardiac emergencies (including trauma) while on call. This means a slightly more onerous on-call commitment than for each individual specialty but it is manageable in terms of work–life balance.
Commitment to training
This is no different to training in either cardiac or thoracic surgery. However, licensing for training (an upcoming GMC requirement) may have an effect on the delivery of training if the specialty continues to divide into separate components. There is no reason why a trainee cannot be exposed to different aspects of the specialty when working with a cardiothoracic surgeon if training is delivered effectively.

Training requirements
At present, there is no firm agreement on the minimum exposure to thoracic surgery that a ‘cardiac themed’ training post requires and vice versa. The likely time is between 1 and 2 years to develop the basic competencies for either discipline. It is therefore difficult to see how a trainee could develop advanced competencies in both cardiac and thoracic surgery during a training programme without a period of post-CCT training (as is the case for congenital cardiac surgery). Those trainees who apply for jobs in mixed practice units will have to provide evidence of their competence. Currently, the training, CCT and intercollegiate exam are in cardiothoracic surgery, and are expected to remain so for the foreseeable future.

The future of mixed practice cardiothoracic surgery
Advances in operative techniques (in cardiac as well as thoracic surgery – including minimal access techniques) have helped to drive specialist practice in both limbs of the specialty. Restricted training time and job planning will only serve to reinforce this position. In England, all new consultant posts in the specialty are currently advertised for provision of a single specialty service and there have been no mixed practice cardiothoracic consultant appointments over the last few years. NHS Specialised Services mandated that thoracic and cardiac services should be clearly differentiated from one another and that thoracic services should be led by single specialty consultants in general thoracic surgery. Training in cardiothoracic surgery is moving towards either ‘thoracic themed’ or ‘cardiac themed’ posts.

As a result of all these influences, it is unlikely that there will be surgeons with a mixed cardiothoracic practice working in England beyond the next decade. The same influences are at work in Wales. Things are less clear in Scotland and Ireland so it remains to be seen how mixed practice cardiothoracic surgery will fare in the medium term.

In contrast, there are changes afoot within the whole of medical services, which in some areas have become highly specialised to the detriment of particular patient groups. It is possible that the Shape of Training initiative may lead to the emergence of a mixed practice cardiothoracic surgeon, who provides a basic service in both disciplines, whereas more complex work would be managed by a single specialty cardiac or thoracic surgeon.
Congenital Cardiac Surgery

Background

Surgery for congenital heart disease has become an increasingly specialised area of cardiothoracic surgery and accounts for 10–15% of the total cardiac surgical workload in the UK and Republic of Ireland, comprising of 5,500–6,000 cases annually. Although the majority of this work (80%) is in babies and children, there is an increasing growth in the population of adults with congenital heart disease (ACHD) who require surgery (either for correction of primary lesions or for the sequelae of procedures performed in childhood). It can therefore no longer be regarded as ‘paediatric’ surgery alone and is more correctly referred to as ‘congenital cardiac surgery’ as this covers all surgery for congenital heart disease from neonates to adults.

The workload has increased steadily at a predictable rate. This is related both to population growth and to innovation within the specialty, which has expanded the range of lesions that can be operated on and the number of patients who can be offered treatment (Figure 4).

Historically, paediatric cardiac surgery was performed alongside adult surgery in the same units and by the same surgeons. However, with increasing intensity, specialisation and expansion in both the range and complexity of the procedures over the last 30 years, there has been a gradual transition into this work becoming delivered by dedicated ‘congenital’ cardiac surgeons. Mixed practice has become a thing of the past and this has now become an established sub-specialty area such that workforce planning is fundamentally based on a pure ‘congenital’ model with well defined patient population and service delivery.*

This area of the specialty has been under intense public scrutiny since the Bristol Royal Infirmary Inquiry of the late 1990s. Consequently, there has been exhaustive analysis of congenital heart services by the Department of Health for the past 15 years. Repeated national directives to redefine standards for service delivery (the Safe and Sustainable review, 2008, and the new congenital heart disease review, 2013) have provided extensive information to help in workforce planning. Nevertheless, accurate calculations will be dependent on the final results of the current review, due in 2015, with an anticipated 3–5 years run-in for units to achieve the required standards.

Congenital cardiac surgery remains one of the most challenging and technically complex areas of the specialty, and it relies heavily on teamwork and mentorship at a consultant level. There is also a very close working relationship with cardiology teams and there are increasing opportunities for hybrid procedures.

Figure 4
Trends in activity in infant and paediatric cardiac surgery

*Transplantation and some specific areas of ACHD remain a ‘grey area’ with overlap to other areas of the specialty but account for <3% of the workload.
Current practice

Overview
The service includes both paediatric and ACHD surgery, which has to be taken into account in terms of workforce planning. Essentially, both components are delivered by the same surgeons and it is easier to make all calculations based on this model. There is a fundamental necessity for paediatric surgery to be embedded within a multi-disciplinary paediatric facility and this will mean that the model of care will vary from one region of the country to another depending on local configurations. As a result, in integrated units, the same ‘congenital’ cardiac surgeons may operate on children and ACHD patients in the same hospital but, in other cases, the adult and paediatric units may be in separate, neighbouring hospitals with the surgeons operating on both sites.

There are currently 12 centres for paediatric cardiac surgery in the UK and Republic of Ireland. Each is linked with an ACHD unit either in the same hospital (n=6) or in a neighbouring adult unit (n=6). This accounts for 97% of all congenital cardiac surgery. However, as shown in Table 4 and Figure 5, there are currently an additional 17 centres that carry out small numbers of ACHD work, which is performed by surgeons whose major practice is acquired adult cardiac surgery. These small numbers of cases will be excluded from workforce calculations since the surgeons are better considered under ‘cardiac surgery’. The recommendations of the new congenital heart disease review will address these relatively isolated areas of practice and may suggest that this work should be either re-designated or redirected into the 12 major centres.
### Table 4
**Hospitals currently undertaking congenital cardiac surgery**

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Paediatric/adult</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>England</strong></td>
<td></td>
</tr>
<tr>
<td>Basildon University Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Birmingham Children’s Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Birmingham, Queen Elizabeth Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Blackpool Victoria Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Brighton, Royal Sussex County Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Bristol Royal Hospital for Children and Bristol Royal Infirmary</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Glasgow, Golden Jubilee National Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Leeds General Infirmary</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Leicester, Glenfield Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Liverpool, Alder Hey Children’s Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Liverpool Heart and Chest Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, Evelina Children’s Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>London, Great Ormond Street Hospital for Children</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>London, Hammersmith Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, Harley Street Clinic</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>London, King’s College Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, Royal Brompton Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, St George's Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, St Thomas' Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>London, The Heart Hospital (University College Hospital)</td>
<td>Adult</td>
</tr>
<tr>
<td>Manchester, BMI Alexandra Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Manchester Royal Infirmary</td>
<td>Adult</td>
</tr>
<tr>
<td>Newcastle, Freeman Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Nottingham City Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Oxford, John Radcliffe Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Sheffield, Northern General Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Southampton General Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td>Stoke-on-Trent, Royal Stoke University Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td>Wolverhampton, New Cross Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td><strong>Wales</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiff, University Hospital of Wales</td>
<td>Adult</td>
</tr>
<tr>
<td>Swansea, Morriston Hospital</td>
<td>Adult</td>
</tr>
<tr>
<td><strong>Scotland</strong></td>
<td></td>
</tr>
<tr>
<td>Glasgow, Royal Hospital for Sick Children</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td><strong>Northern Ireland</strong></td>
<td></td>
</tr>
<tr>
<td>Belfast, Royal Victoria Hospital</td>
<td>Paediatric and adult</td>
</tr>
<tr>
<td><strong>Republic of Ireland</strong></td>
<td></td>
</tr>
<tr>
<td>Dublin, Our Lady's Children’s Hospital</td>
<td>Adult</td>
</tr>
</tbody>
</table>
Congenital cardiac surgery is currently delivered by 42 consultants across the 12 “congenital” cardiac units in the UK and Republic of Ireland. Two units have five surgeons, two units have four surgeons and eight units have three surgeons.

There has been considerable debate regarding the minimum number of surgeons per unit in the NHS reconfiguration proposals of the past years and a final decision is still awaited. The proposed model is to aim for a minimum of four consultants per unit. The SCTS has endorsed this view with the support of the members albeit with the clear proviso that a minimum of four is seen to be the ideal but that teams of three are felt to be acceptable so long as local teams are satisfied that the standards can be met.

If units are to achieve a minimum of four surgeons, there will be a shortfall of eight posts to be filled to achieve these standards.

Any further calculations are almost entirely dependent on the outcome of the new congenital heart disease review, due in 2015, but the likely scenarios can be summarised as:

- **No change in number of centres**: recommendation for a minimum of 4 surgeons per unit (8 additional posts required)
- **Reduction to 10 or 11 units**: minimum of 4 surgeons per unit (0–4 new posts required)
- **No change in number of centres**: no enforcement of minimum surgeon numbers (no change)

The age distribution of the current congenital cardiac workforce is shown in Table 5. It is estimated that nine consultants will retire over the next ten years.

### Table 5

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of consultants</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-40 years</td>
<td>4</td>
</tr>
<tr>
<td>40-50 years</td>
<td>20</td>
</tr>
<tr>
<td>50-60 years</td>
<td>13</td>
</tr>
<tr>
<td>&gt; 60 years</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>

### Changes in the current workforce

A review of UK and Irish congenital cardiac posts over the past 15 years reveals that there has been a gradual increase in the number of surgeons delivering congenital cardiac surgery from 28 in 2000 to 42 in 2015. This partly reflects an increase in the workload from 4,000 cases to nearly 6,000 in the same time period but also the fact that the complexity of the lesions treated has increased together with the amount of neonatal work (increased by 300 cases per year) and extra-corporeal membrane oxygenation (ECMO) support.

There have also been 6 consultants who left the UK to work abroad (3 went to the US, 1 to Australia, 1 to Italy and 1 to Denmark) and 11 retirements during the last 15 years. Consequently, there have been 31 new consultant appointments in the UK and Republic of Ireland over the past 15 years.

### Job plans

The concept of ‘consultant congenital cardiac surgeon’ has probably undergone its greatest period of evolution over the
past 20 years and is now emerging as what is felt to be a better defined role with less need for change. Mixed practice is gone and the emergence of “dedicated” congenital cardiac surgeons working in teams is now the norm, covering the whole spectrum of congenital heart disease from neonatal work to treating adults.

There is considerable emphasis on the multi-disciplinary team approach to decision making for all congenital cardiac patients, which has become an essential component of all job plans. This is true for both the paediatric workload and the ACHD workload, and most consultants are expected to be committed to both these components of the service, which may be on different sites depending on the local arrangements.

The nature of the surgery is extremely demanding in terms of technical complexity, variety and the range of procedures in which proficiency is required. (There are 39 different primary procedures alone that are recorded on the National Institute for Cardiovascular Outcomes Research annual analysis.) Neonatal work can be very demanding. It can involve long procedures and close inter-disciplinary management on the paediatric intensive care unit post-operatively, all of which needs to be recognised in job planning. Operating on children carries the additional pressures and stresses of dealing with parents and families, and the emotional issues for all of us in caring for sick children. The annual activity for paediatric cardiac surgery across the UK and Republic of Ireland is shown in Figure 6.

Proposed guidelines, supported widely by the SCTS membership, suggest that a minimum caseload of 125 congenital cardiac cases per surgeon should be a useful annual guide to activity. Based on consultants providing service delivery over 42 weeks of the year, the expectation is that job plans include at least 1.5 operating days per week and, more commonly, 2.0 operating days. Job plans must include adequate allocation of time for attendance at multi-discipline team meetings as well as acknowledging the audit commitments of providing accurate and timely submissions to the National Institute for Cardiovascular Outcomes Research.

Although there will inevitably be some degree of ‘super-specialisation’ within any unit (with individual surgeons having their own area of special interest), the principle of congenital

**Figure 6**
Paediatric cardiac activity in 2012–2013. (Note that John Radcliffe Hospital in Oxford and Royal Victoria Hospital in Belfast are no longer taking paediatric cardiac cases.)
cardiac teams is that surgeons are competent across the spectrum of the workload, and able to provide safe and competent emergency cover across all age groups around the clock. Neonatal surgery accounts for 20–25% of the workload. By definition, this is unpredictable work, meaning that out-of-hours commitments are relatively onerous. This is compounded by the fact that post-operative management frequently requires bedside management by joint surgical and paediatric intensive care unit teams, and there is an increasing use of ECMO for both respiratory and cardiac support in neonates and infants. This is a consultant-delivered service and generally takes place out of hours.

Dual operating is strongly supported and has long been an integral part of the close teamwork that defines congenital cardiac surgical teams. The complexity and high risk nature of much of the neonatal and infant surgery is such that dual operating has been invaluable in maximising expertise and professional support for colleagues as well as being instrumental in the professional development and mentorship of newly appointed consultants. The recognition of dual operating in job plans is strongly supported.

Outpatient commitment in paediatric surgery is relatively limited as a great deal of follow-up outpatient work is done by paediatric cardiologists, who are trained paediatricians. The majority of outpatient department work consists of pre-operative counselling visits.

In summary, congenital cardiac job plans have become more uniform over the past ten years. In order to reflect the high intensity of the workload, the need for adequate operating sessions and the regular on-call commitments, most jobs typically attract 10+2 PAs per week.

**Work-life balance**

The intensity of the workload and the nature of the work make for a potentially stressful job with unsocial hours and a heavy clinical commitment. This is at least partially mitigated by the close teamwork that is necessary in congenital cardiac units, and the general acceptance for colleagues to readily cross-cover and share post-operative care. The single factor that is most likely to influence work–life balance is the push towards larger teams of surgeons to increase the amount of peer support and provide more sustainable on-call rotas. The level of commitment to the work, which is inherent to the profession, will mean that job plans are unlikely to change significantly in the next ten years. The need for adequate operative exposure as well as appropriate clinical and governance activity is such that working hours cannot easily be stripped back any further.

**Predicted changes in activity**

Considerable work has been done over the past seven years on analysing the workload of congenital cardiac surgery and its relationship with population growth as well as changes in population demographics in terms of ethnicity, birth rates and social deprivation scores. Unfortunately, these data are limited largely to England and Wales since Scotland and Ireland have not been part of the reconfiguration exercises.

There are four main drivers to consider when calculating the impact of population growth on activity (and therefore on workforce planning):

1. The incidence of congenital heart disease in newborns remains remarkably constant at 8 cases per 1,000 live births but there are some slight racial variances with a slightly higher incidence among Asian ethnicity.

2. Developments and innovations in the specialty itself have led to surgery being offered for conditions that were previously untreated. In addition, as the results of surgery continue to improve, there are children who previously would not have survived who now come forward for further planned staged procedures. The consequence of this is that the number of procedures performed per 100,000 population increases gradually over time (Figure 7). This also has to be factored in when considering future activity.
The impact of these first two factors are shown in the graph below (fig 5) that predicts the likely increase in congenital cardiac surgical cases based on Scenario A (predicted population growth alone) and on Scenario B (population growth plus predicted increase in activity per head of population):

Figure 8
Predicted increase in paediatric congenital cardiac surgical activity over the next ten years. Scenario A is based on population growth only. Scenario B is based on population growth and increased activity per head of population.

3. The ACHD population is increasing out of proportion with general population growth. This reflects the fact that so many more children with congenital heart disease are now surviving into adulthood and living longer than ever before. Consequently, the number of patients who require ongoing care, surveillance and re-operation also increases. This is the largest growing area of congenital cardiac work. The same population predictions can be used in the ACHD population and are shown in Figure 9.

Figure 9
Predicted increase in adult congenital cardiac surgical activity over the next ten years. Scenario A is based on population growth only. Scenario B is based on population growth and increased activity per head of population. However, NICOR ACHD data are affected by increases in the number of providers reporting over time. Scenario B is distorted by this and should therefore not be used. It is included for completeness.

4. There are some regional variations in activity as some areas (e.g. the South East and the West Midlands) have large immigrant populations with relatively higher birth rates and ethnic groups with higher incidence of congenital heart disease.
Summary
Based on predictions for England and Wales alone, there is an assumption that these changes will be similar in Scotland and Ireland. There is expected to be an annual increase of 0.4–1.0% in paediatric cardiac surgical procedures per year and a 0.7–4.0% increase in ACHD surgical procedures. This translates to a 5–14% increase in paediatric procedures by 2025 and a 10–67% increase in ACHD procedures. This additional workload will probably require an additional 4–8 consultant posts by 2025.

Training in congenital cardiac surgery
Owing to increased specialisation and the fact that consultant posts had now become posts dedicated exclusively to a congenital cardiac practice, a new sub-specialty of congenital cardiac surgery was recognised in 2013. The parent specialty is cardiothoracic surgery, and all trainees undertake the full breadth of adult cardiac and thoracic surgical training in line with the national curriculum, leading to the intercollegiate exam in the generality of the specialty. However, trainees wishing to specialise in congenital cardiac surgery are then able to apply for sub-specialty training, which involves two years spent in dedicated congenital cardiac units, comprising the final two years of training before award of the CCT.

Trainees have to undergo competitive interview to enter sub-specialty training and annual competency review. Successful trainees receive their CCT in the parent specialty but with sub-specialty recognition in congenital cardiac surgery. It is expected that all trainees who have achieved the CCT after 2014 will be required to have sub-specialty recognition before being eligible to apply for a congenital cardiac post in the UK.

There is considerable enthusiasm to provide training in congenital cardiac surgery across all the centres in the UK and Republic of Ireland, with all having deanery approved training positions. Every unit contributes to training individuals, be they junior trainees (as a ‘taster’ forming part of their general cardiothoracic training) or more senior trainees keen on making this their most senior of trainees. The use of indicative numbers to help drive the caseload has been roundly supported by trainees and the expectation is that trainees going through the sub-specialty programme will have performed a minimum of 75 index procedures in that time.

The curriculum is up to date and covers the full spectrum of the specialty. The greatest challenge remains the provision of adequate operative experience for the trainees in an environment of such extreme scrutiny and where the technical complexity of the procedures makes them difficult to teach to all but the most senior of trainees. The use of indicative numbers to help drive the caseload has been roundly supported by trainees and the expectation is that trainees going through the sub-specialty programme will have performed a minimum of 75 index procedures in that time.

Total workforce calculation
Points to note include:

- **Current workforce**: This is probably very marginally understaffed and would ideally require an additional 3–5 consultant appointments.
- **Impact of reconfiguration**: It is most likely that an additional 4–6 appointments will be made over the next 3–5 years.
- **Expected retirements**: These are likely to lead to 9 new appointments in the next 10 years.
- **Population growth** (especially in the ACHD population): This is likely to lead to the need for 4–8 additional consultants in the national workforce by 2025.

Although we have the benefit of detailed population data and a relatively well defined incidence within the population, it must be noted that we do not have accurate figures for Scotland and Ireland. Second, the long awaited decision of reconfiguration of congenital cardiac services in England and Wales will also impact on the workforce, and any calculations have to mitigate for the various possible outcomes of the review. Nevertheless, reconfiguration may impact more on exactly where the surgery is performed rather than national workforce numbers.

The specialty needs to be prepared to address the potential impact of reconfiguration and the implications of the standards for congenital cardiac care, which are expected to come together with the findings of the new congenital heart disease review and through the new clinical reference groups. This may require the appointment of up to 4–8 additional consultants over the next 5 years.

The workforce is well balanced in terms of age ranges and there is expected to be an average of one retirement per year over the next ten years together with a relatively predictable and gentle increase in the national workload. These factors combined suggest that there will be a steady requirement for 1–2 new consultant appointments in congenital cardiac surgery every year for the next 10 years.
Cardiopulmonary transplantation

Background

Heart and lung transplantation was established in the UK in the 1980s. It is commissioned by NHS England in five provider centres, each delivering a full service of heart and lung transplantation as well as both short- and long-term mechanical circulatory support. The five centres are:

- Papworth Hospital NHS Foundation Trust
- Royal Brompton and Harefield NHS Foundation Trust
- University Hospital of South Manchester NHS Foundation Trust
- Newcastle upon Tyne Hospitals NHS Foundation Trust
- University Hospitals Birmingham NHS Foundation Trust

An additional Scottish centre in Glasgow provides a heart transplantation and ventricular assist device service only. Lung transplant services for the people of Scotland are provided by Freeman Hospital in Newcastle through a commissioned service with the National Services Division in Scotland.

Both the Newcastle upon Tyne Hospitals NHS Foundation Trust and Great Ormond Street Hospital for Children NHS Foundation Trust are additionally commissioned to provide heart and lung transplant services for the paediatric population.

Transplantation usually forms part of an advanced heart and lung failure service provided by teams of surgeons, physicians, transplant co-ordinators and allied staff (social workers, physiotherapists, psychologists and palliative care staff). All heart transplant centres now also offer active programmes of short- and long-term mechanical circulatory support intended primarily as a bridge to heart transplantation although implantation of devices may sometimes lead to recovery and explantation of the system. Furthermore, the units provide short-term support with ECMO or centrifugal pump technology (left, right or biventricular support) for use in critically ill patients as a salvage manoeuvre, a bridge to decision making or to urgent transplantation.

Units are also experienced in providing post-transplant heart and respiratory support with ECMO in the case of primary graft dysfunction although it should be noted that respiratory ECMO outside of the context of transplantation is a separately commissioned service.

The donor heart and lung retrieval programme is commissioned separately by NHS Blood and Transplant. Each transplant centre provides teams to the National Organ Retrieval Service who are funded to be available 24 hours a day to respond to every potential heart and lung donor offered for transplantation, and, in some cases, to provide a service in donor optimisation, care and assessment.

Current practice

Overview

There are approximately 250 patients in the UK currently on the active heart transplant waiting list and approximately 270 patients on the lung transplant waiting list. An additional 15 patients are on the combined heart and lung transplant list. The number of patients on the waiting list varies between the centres but Newcastle and Harefield have the largest cardiothoracic lists with between 100 and 120 patients actively listed at each of these units.

Heart transplantation has been falling in incidence over the last decade from approximately 300 per annum to 100 per annum. In 2013–2014, however, it had increased by 37% to 198 cases, partly because of the widespread use of donor optimisation teams from the transplant centres.

The nature of patients receiving heart transplants has changed, with 75% of recipients now being urgently listed cases. Recently, a new super-urgent listing category has been agreed. In 2013–2014, 218 lung transplants were performed, which is an increase from approximately 150 per annum between 2004 and 2010.

The overall heart transplant list rate at 31 March 2013 was 4.1 patients per million population, ranging between 2.2 and 9.2 across the strategic health authorities. The overall lung transplant list rate was 4.5 patients per million population, ranging between 2.5 and 6.2.

Transplantation continues to be limited by a donor organ shortage and, within six months of being listed for a transplant, 31% of non-urgent heart transplant patients receive a heart transplant and 5% have died while waiting. Where appropriate, patients who deteriorate while on the waiting list will be given mechanical circulatory support, which may or may not bridge them to transplantation. For lung transplant patients, 39% are transplanted within six months, rising to 68% after three years. Transplant units are now actively involved in donor optimisation and other techniques such as ex vivo perfusion to maximise the use of available organs.

Transplant surgeons

Transplant surgeons may be drawn from either cardiac or thoracic surgery, with the latter undertaking lung transplantation only, and the former undertaking a combination of heart and lung transplantation alongside ventricular assist device implantation and short-term mechanical circulatory support. Pure thoraco-transplant surgeons are a rarity in the UK although this model of specialism is widespread in Europe and North America.

Surgeons practise cardiopulmonary transplantation alongside a standard workload in either cardiac or thoracic surgery. The work is onerous and intense. Surgeons on the on-call rota are required to field potential donor offers day and night, and provide advice to retrieval teams regarding the suitability and acceptance of organs for implantation. In some centres, consultant surgeons participate in the retrieval rota. Inevitably, the majority of this work takes place out of hours, usually in the early hours of the morning. Surgeons are then required to embark on complex and challenging transplant surgery in critically ill recipients. The surgery is long and demanding, requiring significant mental and physical stamina.

The surgeon’s ability to practise across a wide range of multi-specialist disciplines is crucial as the successful transplantation of patients requires input not only from surgeons but also from cardiologists, respiratory physicians, anaesthetists, transplant co-ordinators, microbiologists, tissue typing scientists, physiotherapists and nursing staff. An ability to interact professionally and communicate well with a wide range of disciplines is vital to those involved in this area of practice, such as the complexity of assessment, surgery and aftercare of these patients.
Current standards
The 2013/14 NHS Standard Contract for Heart and Lung Transplantation Service is set out in service specification A18/S. Cardiopulmonary transplantation services are expected to provide full assessment of suitability of patients for transplantation and to register those patients with NHS Blood and Transplant. Pre-operative assessment, hospital-based care, post-transplant follow-up and long-term care all fall within the remit of the transplant service, in which the surgeon is a pivotal component. The implementation of the Organ Donation Taskforce provided a number of recommendations intended to increase the overall number of actual donors and it is likely that the number of non-heart beating donors will continue to increase significantly, bringing about increases in lung transplants.

Advances in ex vivo perfusion technology in the coming years may also lead to a small number of additional heart transplants from donors after circulatory death. The overall number of deceased donors suitable for donation of heart and/or lungs after brainstem death is expected to rise as well (although not as dramatically) as improvements in donor optimisation and critical care yield potentially more usable organs for transplantation. The development of ventricular assist device services alongside transplantation units has enabled many patients with end-stage heart failure to survive long enough for a suitable donor heart to be identified. This technology has influenced the perceived likelihood of heart availability and has the potential to impact significantly on the overall level of demand for heart transplantation.

The standards emphasise the requirement for surgeons to be involved in pre-transplant assessment through participation in multi-disciplinary team meetings and assessment procedures to evaluate the patient’s clinical, social and psychological suitability as a transplant recipient, and as part of the process for imparting factual information to the patient and his or her family concerning all aspects of transplantation. Transplant surgeons are responsible for determining the suitability of individual donors, and balancing the risks and benefits of individual donors to particular recipients. This process is almost always out of hours.

Transplant surgeons may also be involved in the long-term follow-up of patients as well as in outpatient clinics dealing with issues of graft dysfunction and failure, infection in immunosuppressed patients and the monitoring of immunosuppressant medication. Surgeons are involved in the joint care of patients with anaesthetic colleagues in the intensive care unit and when there is a need for short-term circulatory or respiratory support.

On-call commitments
Cardiopulmonary surgeons practising transplantation will usually be on an on call rota combining either cardiac or thoracic surgery with their transplant on call commitment. The standards indicate that UK units should work towards a minimum of 5 Consultant Surgeons capable of undertaking heart or lung transplantation and at least 3 involved as part of a left ventricular assist device programme. Departments may allow different surgeons in each team but must have a sufficient number to publish a robust on call rota.

International evidence suggests that high heart transplant mortality is seen in units with low activity and UK units have agreed to work towards a minimum of 25 heart transplants and 25 lung transplants performed per annum with approximately 5 heart or lung transplants performed each year by each individual surgeon on the on call rota.

Work-life balance
Owing to the onerous nature of transplantation and the commitment to retrieval and/or donor assessment, there can be a major detrimental impact on surgeons’ personal lives. Being on call for both transplantation and general cardiac or thoracic surgery (and in some cases all three) can place considerable strain on an individual. By their very nature, transplant patients are complex and very sick in advanced stages of heart or lung failure. The surgery required for transplantation is high risk, challenging and complicated, and it is usually conducted out of normal working hours after a normal working day.

On-call duties will run concurrently with general responsibilities in cardiothoracic surgery, and the unpredictable and onerous nature of the work causes considerable interference with proper rest periods. Sleep deprivation is experienced on a regular basis throughout the surgeon’s career. It is highly unlikely for most transplant surgeons to have an undisturbed night’s sleep prior to undertaking a transplant procedure and they will usually have carried out a full day’s work ahead of their on-call period. Transplantation places considerable stresses and strains on those committed to this field, on top of the normal and difficult burden of general cardiac or thoracic practice.

Previous workforce evaluations
In 2009 the Cardiothoracic Advisory Group of NHS Blood and Transplant and the SAC jointly undertook a formal review of staffing and training opportunities for the current and future service led by the late Professor Robert Bonser and Mr Tim Graham. Each centre was reviewed individually and representatives were interviewed.

It was understood at this stage that the national service needed to develop robust staffing and training requirements. In this review, it was recognised that the consultant surgical workforce was senior both in terms of experience and age, and that a number of replacement posts were needed to maintain the service over the next decade. A total of 24 new posts were deemed to be required over that time period. It was acknowledged that in many cases a step down from the transplantation rota, given its onerous activity, may predate actual retirement from conventional practice for some consultants and individual unit-based approaches to establish a transplant on-call rota would be necessary in such circumstances.

It was suggested by the SAC and the Cardiothoracic Advisory Group that specific peri-CCT fellowships of 18 months’ duration should be established and that 2 posts should be offered (one at Papworth and one in Newcastle). These should be aimed at the training of consultant surgeons for the national transplant programme. Such fellowship positions were to be approved in advance by the SAC, and quality assured by both the SAC and the local school of surgery or deanery. For trainees undertaking such fellowships, it was recommended that the CCT date be deferred until the post was completed. It was hoped that additional training programmes may be added at Harefield
Hospital or as a combined initiative between Wythenshawe Hospital in Manchester and Queen Elizabeth Hospital in Birmingham but thus far additional peri-CCT fellowship programmes have not been approved.

In the 2009 review, it was felt that a transplant specific training programme that could deliver 4 consultants every 18 months would largely satisfy the requirements of the national programme for the next decade. Transplantation was recognised in the review as an unpopular and onerous sub-discipline of the specialty of cardiothoracic surgery, which required recruitment and retention incentives to maintain and augment the current workforce. This has in fact been demonstrated by low numbers of applicants for the peri-CCT posts since 2009 and one post-fellowship trainee entering a non-transplant post after completion (Table 6). There were no applicants at all for the two peri-CCT transplant fellowships advertised in 2014.

**Table 6**

<table>
<thead>
<tr>
<th>Location</th>
<th>Completed Fellowship Training</th>
<th>UK Transplant Consultant appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Papworth</td>
<td>Yes</td>
<td>Yes (Manchester)</td>
</tr>
<tr>
<td>2. Newcastle</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. Papworth</td>
<td>Yes</td>
<td>Yes (Manchester)</td>
</tr>
<tr>
<td>4. Newcastle</td>
<td>Yes</td>
<td>Yes (Birmingham)</td>
</tr>
<tr>
<td>5. Papworth</td>
<td>Yes</td>
<td>Yes (Birmingham)</td>
</tr>
<tr>
<td>6. Newcastle</td>
<td>Yes</td>
<td>Presently a locum cardiac and transplant surgeon in Newcastle but applying for a substantive post</td>
</tr>
</tbody>
</table>

In January 2013 NHS Blood and Transplant, the National Services Division in Scotland and NHS Specialised Services commissioned an expert panel to examine issues surrounding adult cardiothoracic transplantation in the UK. This panel examined detailed evidence from each transplant unit in light of the growing concerns in 2011 expressed by senior clinicians and commissioners (and led by Professor Sir Bruce Keogh, the NHS Medical Director) over the sharp fall in heart transplantation and maintaining recruitment of new consultant surgeons to the national transplant service.

Existing centres were asked to present plans for improvement such that the standards for a high quality sustainable UK cardiothoracic transplantation service could be met by 2015. Analysis by this panel indicated that to ensure a secure future, a surgical rota of five consultant surgeons capable of undertaking heart or lung transplantation with at least three surgeons involved in left ventricular assist device implantation was necessary. A team of cardiologists with experience in heart transplant assessment as well as post-operative care and follow-up allied to a similar team of respiratory physicians for lung transplantation was required, with a full multi-disciplinary team involved in the assessment, intra-operative management and follow-up of transplant patients. There was an expectation of individual activity of consultant cardiothoracic surgeons to approximate five heart transplants and five lung transplants per year as a minimum.

It was acknowledged in the panel’s report that cardiothoracic transplantation services face significant workforce planning challenges to enable the current configuration of centres to remain sustainable. It was also recognised that the number of transplant surgeons recruited in the UK has not been sufficient to address the identified minimum standard.

Over the previous three years, there had been a number of senior surgeons withdrawing from the transplant rota and at least four transplant surgeons up until January 2013 had left the UK to work abroad. If the service were to work to the minimum service standard of five actively transplanting surgeons in each centre, then a minimum of eight additional cardiothoracic transplant surgeons would need to be recruited by 2015, assuming that no existing surgeons leave during that period. This also assumed that the newly recruited surgeons can perform both heart and lung transplants, and would be on both heart and lung transplant on-call rotas.

Proposals submitted from the transplant centres indicated that a minimum of 13 additional cardiothoracic transplant surgeons would be recruited by 2015 and, if achieved, these plans would enable each English centre to meet the minimum standards for the workforce. However, at the time of writing, this has not yet been achieved. The report also indicated that there was a clear and inextricable link between the centres’ transplant activity levels and the training offered but of the fellowships provided, not all have resulted in appointments to transplant posts in the UK.

It was recognised that a career in cardiothoracic transplantation surgery has become less attractive to surgical trainees, and that the complex, stressful, unpredictable and often nocturnal nature of the discipline means that transplantation can be perceived as having a very poor work–life balance in comparison with other surgical sub-specialities. Furthermore, it was appreciated that job plans should reflect the full range of interventions for heart failure and respiratory failure services, including mechanical circulatory support and evolving technology for bridging to transplantation. The widening of the scope of job plans beyond implantation alone may make roles more appealing to new consultant surgeons but overall it was deemed highly unlikely that the national programme would successfully recruit the 13 cardiothoracic transplant surgeons required by 2015 as proposed by the centres during this investigation.

The tables on the following pages show the current status of transplantation in each unit. (Note that ‘new posts’ are those expected in the next five years as a result of new appointments or retirements.)
### BIRMINGHAM

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (1 lung only)</td>
<td>50–55 years (n=2)</td>
<td>1:5</td>
<td>1 or 2</td>
</tr>
<tr>
<td></td>
<td>45–50 years (n=2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40–45 years (n=0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35–40 years (n=2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Job Plan**
Not specifically recognised in current job plans but negotiating for 2.5 PAs

**Training**
3 transplant fellows (specialty doctors)

**Comments from the director of transplantation**
Recent staffing issues have led to a robust implementation of plans for the consultant workforce. When involved in operative transplantation, there is a palpable interest in transplantation. However, a lack of suitably experienced (end of training) registrars at present makes operative training difficult. The younger trainees have shown a large amount of interest in the mechanical circulatory support programme. In short, there has been interest from trainees but whether this is maintained throughout their training is uncertain and, as with other centres, there is concern about consultant recruitment in the future.

### PAPWORTH

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>50–55 years (n=2)</td>
<td>1:7 (transplant / ventricular assist device)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>45–50 years (n=3)</td>
<td>1:5 (retrieval)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40–45 years (n=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35–40 years (n=1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Job Plan**
2.66 PAs for all transplant activities

**Training**
3 transplant fellows, 1 rotating NTN, 1 peri-CCT fellow

**Comments from the director of transplantation**
It is obviously very difficult to balance adequate experience, maintain competence versus develop excellence, double consult and double scrub to support younger colleagues, rostered duty versus goodwill, career ambition, work–life balance and over dilution, general cardiac workload, on-call rota for non-transplant cardiac emergencies, sustainability etc. Each individual choosing to perform transplants will have to make a decision about what and how much to sacrifice.

### NEWCASTLE

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (1 lung only, 2 heart only) Also 2 ACHD heart transplant surgeons</td>
<td>&gt;60 years (n=3)</td>
<td>1:7</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>55–60 years (n=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50–55 years (n=2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45–50 years (n=2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40–45 years (n=0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35–40 years (n=0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Job Plan**
2.5 PAs for all transplant activities

**Training**
1 fellow, 3 specialty doctors, 1 rotating NTN, 1 peri-CCT fellow

**Comments from the director of transplantation**
Transplantation continues to be a very onerous commitment on top of busy cardiac and thoracic workloads. Multiple phone calls concerning donor offers as well as arduous, complex and high risk operations out of hours make a healthy work–life balance difficult, and this adds considerably to the stresses felt by colleagues. The unpopularity among young surgeons is palpable and gives concern for the future of the service as recruitment to future consultant posts is uncertain.

### GLASGOW

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>45–50 years (n=2)</td>
<td>1:1.5 (includes retrieval duties)</td>
<td>2</td>
</tr>
</tbody>
</table>

**Job Plan**
2 PAs

**Training**
3 fellows (no rotating NTN trainees)

**Comments from the director of transplantation**
The current rota is extremely demanding. We appointed one new consultant, who cannot start before July 2015. Retrieval rota is very difficult to staff.
### MANCHESTER

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
</table>
| 8 (2 heart only & 2 lung only) | >60 years (n=1)  
55–60 years (n=1)  
50–55 years (n=2)  
45–50 years (n=1)  
40–45 years (n=2)  
35–40 years (n=1) | 1:6 | 2 (one heart and 1 lung) |

#### Job Plan
Assessment meetings and clinics are included in a 12PA job plan. Transplant cases are paid per case in addition.

#### Training
Yes but depends on trainee choice to rotate into transplantation. Transplant fellows.

#### Comments from the director of transplantation
There have been many discussions in the recent past regarding providing a surgically focused transplant service but with adequate rota frequency (to help lifestyle), how best to remunerate transplant work (as it is difficult to attract other income if you are a committed transplant surgeon), and how to attract young colleagues to a specialty that is surgically demanding and requires hard work (as most work is outside normal hours).

I believe every unit needs a minimum of three core transplant surgeons who focus on the transplant work, supported by other interested colleagues to make up the rota. (Ideally, it should be a 1:3 rota with a good remuneration package.) There should be double scrubbing for all complex transplants to safeguard patients and for the training of new surgeons. Transplant surgeons should be given an incentive (like a merit award) and allowed to retire early, say aged 55–60 (at the latest), on a full pension. This may attract the cream of the crop as there are currently no incentives. Training should be planned ahead and focused into transplant centres, with juniors rotating to transplant with a minimum of three months and being allowed to sub-specialise in transplantation from, say, year 4. They are encouraged to attend one-year fully supported external transplant fellowships. Training should match the future demand in the UK.

### HAREFIELD

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>40–50 years (n=5)</td>
<td>1:3</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Job Plan
Included in PAs – not specified

#### Training
No trainees

#### Comments from the director of transplantation
As there is no private practice work in transplantation, the NHS should reflect on that and offer bonus compensation to transplant surgeons.

### DUBLIN

<table>
<thead>
<tr>
<th>Number of Surgeons</th>
<th>Age range</th>
<th>On-call frequency</th>
<th>New posts expected</th>
</tr>
</thead>
</table>
| 8 (4 heart and lung, 2 heart only, 2 lung only) | 45–50 years (n=4)  
40–45 years (n=2)  
35–40 years (n=2) | Variable: 1:1 to 1:4, depending on other specialties covered | 1 |

#### Job Plan
No recognition. Small on-call allowance.

#### Training
3 posts: 1 permanent senior fellow and 2 6-month rotating trainees

#### Comments from the director of transplantation
Unfortunately, transplantation is not covered in our job description and we are given a very small on-call allowance (much less than for a registrar) so in this situation we are different than the UK, US and other places, and this needs to change so that we can continue to attract people to transplantation. With regard to future staffing, the rotas are onerous. Although they are probably OK when you are in the younger half of your consultancy, they quite difficult in the second half when you get older. This does affect the work–life balance. There is the usual problem of needing to do a certain amount of cases and yet not doing too onerous rotas. Incentives do work and need to be used in Ireland more to keep people in and attract people to transplantation. At a higher training level in transplantation, there needs to be almost a guarantee of a job at the end of training to attract people into it and to value people's contribution.
Summary

The discipline of cardiopulmonary transplant surgery remains a challenging and onerous career but is also highly rewarding on a professional level. Practice has widened in recent years to include short- and long-term mechanical support as well as the provision of adult ECMO. Donor management has advanced and now includes comprehensive donor optimisation, which requires consultant supervision. Exciting new organ perfusion strategies such as ex vivo lung perfusion continue to expand research and clinical opportunities for transplant surgeons.

Nevertheless, it was accepted in the 2009 and 2013 national reviews of workforce planning for transplantation that it remains an unpopular specialty for new cardiothoracic surgeons. The complex, high risk and time consuming nature of transplant surgery and the fact that the work is largely nocturnal has dissuaded many from this career path. The lack of incentives and poor recognition in job plans have added to the problems. The threat to provision of the national service was clear in both reviews, with poor recruitment being noted. The establishment of the peri-CCT fellowship schemes was a positive step forward to address this but it has been unpopular; with no applicants at all for the most recent recruitment round. Since the scheme started in 2009, four substantive (and one locum) transplant consultant posts have been filled by peri-CCT fellows. This is well short of the number required.

The survey of units in this report shows the diversity in the service and the lack of unity in job planning. All centre directors remain concerned about the future of the discipline without radical change. The survey indicates the need for a minimum of 11 transplant posts in the next 5 years, assuming no changes in current staffing. This is well beyond the scope of the national peri-CCT fellowship scheme. Units are encouraged to rotate NTN trainees through transplantation to foster interest in the discipline as a future career but only three units do so formally as short six-month rotations.

A radical solution must be found to provide a sustainable workforce in transplantation and to maintain the national service in the short term.
Academic cardiothoracic surgery

Background

Cardiothoracic surgery has historically lent itself to academic study. It is a clinical scenario characterised by high rates of morbidity that is managed by a highly motivated and innovative workforce keen to improve outcomes and efficiency. The desire to measure and improve has been assisted by large numbers of patients with relatively well defined risk factors and operative procedures as well as important clinical outcomes that may be measured within days or months of surgery. It has been suggested that coronary artery bypass grafting has been evaluated more carefully than any other clinical intervention in the history of medicine. This has contributed to progressive improvements in care and outcomes; mortality following cardiac surgery has shown an almost linear reduction over the last 40 years.

Current practice

Overview

Of the 51 cardiothoracic surgery centres in the UK and Republic of Ireland (27 in England, 3 in Scotland, 2 in Wales, 1 in Northern Ireland and 5 in the Republic of Ireland), 5 units had a total of 14 university senior academic appointments, which included 9 professors, 1 reader and 4 senior lecturers/associate professors. There were no university academic appointments in Scotland, Wales or Northern Ireland. Eight of the fourteen university appointments were concentrated in three units: Bristol, Newcastle and Leicester. In addition, 28 units had a total of 58 honorary senior academic appointments. These included 15 honorary professors, 3 honorary readers and 44 honorary senior lecturers/associate professors. The breakdown of senior academic posts by sub-specialty is shown in Table 7.

Job plans

The typical research commitment for university appointed staff is 5–6 academic PAs per week, equating roughly to a 50/50 clinical/research split. Eleven consultants (9 adult cardiac, 1 cardiothoracic, 1 thoracic) who did not have university academic appointments reported receiving specific university or trust funding in their job plans to undertake research or other academic activities; the commitment ranged from 0.25 PAs to 3 PAs per week.

Work–life balance

The main attraction of academia is the ability to provide evidence that may change practice for the better. The challenges are those faced by any surgeon with a mixed practice; the individual must remain at the forefront of both specialties.

Training in academic cardiothoracic surgery

The National Institute for Health Research (NIHR) Integrated Academic Training Programme provides a clear route for young doctors who may wish to become academic cardiothoracic surgeons. NIHR academic clinical fellowships and clinical lectureships are appointed through selected academic programmes. The posts are allocated to institutional partnerships of universities, NHS trusts/organisations, and local education and training boards, the latter having taken over the functions of postgraduate deaneries from April 2013. Academic trainees are recruited by the local education and training boards through open competition.

Lasting three years, academic clinical fellowships allow trainee surgeons recruited at ST1–3 to undertake research for 25% of their time and use the remaining 75% for clinical training. The intention is that this may lead to a period of full-time research and a higher degree (MD, PhD). Higher degrees may be funded by local universities or biomedical research units, or by research funders such as the British Heart Foundation or the Welcome Trust. Trainees who have been awarded a higher degree are eligible for NIHR lectureships, which provide funding and allow up to 50% of their time until the completion of training for research.

In 2015 the number of junior academic appointments in the UK was as follows: 3 NIHR academic clinical lecturers, 5 NIHR academic clinical fellows and 27 research fellows studying for higher degrees (PhD/MD). There are an additional three lecturer positions in the Republic of Ireland.

<table>
<thead>
<tr>
<th>Post</th>
<th>Adult Cardiac / Cardio-thoracic</th>
<th>Congenital Cardiac</th>
<th>Thoracic</th>
<th>Transplant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Reader</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sen Lecturer / Associate Professor / Clinician Scientist</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Hon Professor</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Hon Reader</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Hon Sen Lecturer</td>
<td>39</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>11</td>
<td>7</td>
<td>5</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 7

Number of senior academic posts by sub-specialty
The future of academic cardiothoracic surgery

Despite the achievements of academic cardiac surgery, it remains a contracting sub-specialty. Of the nine university professors identified in our survey, five were over 60 years of age, two were in their 50s and two were in their 40s. This reflects a contraction in academic cardiac surgery more generally that can be attributed to diminished surgical activity in North America, traditionally the main generator of cardiac surgery research.

In the UK, this contraction is also due to the increasing demands of operative surgery that has a progressively greater emphasis on governance, coupled with the increased complexity of research such that research projects are unlikely to be successful unless they are well funded and undertaken by large groups of researchers. On the one hand, this drives up quality; most of the important clinical trials in cardiac surgery in the last five years (ART, TITRe 2, ERICCA) have come from the UK. On the other hand, this acts as a disincentive to those who may have a research interest but not the time or access to specialist resources to test hypotheses.

In contrast, academic thoracic surgery, which has historically been less well developed than academic cardiac surgery, has seen a resurgence in recent years. This is a reflection of the expansion of the sub-specialty generally, increased awareness of the role of thoracic surgery in the treatment of malignancy, and the introduction of new techniques and procedures. Nevertheless, the number of academic thoracic surgeons remains low (2 university chairs in the UK), which risks leaving the UK behind its competitors in terms of innovation and its translation to clinical benefits.

Immediate strategies to address these shortfalls in academic cardiothoracic surgery would be to appoint a higher number of NIHR fellowships and lectureships to specifically accredited training programmes. The British Heart Foundation has been promoting specific clinical research training fellowships for surgeons with the intention of increasing academic activity. The establishment of an SCTS academic and research committee that provides updates on the status of training to the SCTS Executive Committee and the SAC will be a further positive step. Academic medicine and clinical research is an important contributor to the UK economy and owing to the emergence of the NIHR, there has never been a better time to be an academic clinician. With an established training pathway as well as support from funders and the SCTS, the future is very bright for those wishing to become academic cardiothoracic surgeons.
Medical school recruitment

Traditionally, there has been very little exposure to cardiothoracic surgery in the medical school curriculum. There is also very little exposure in foundation training. This was also true in the past when very few pre-registration surgical house jobs were based in cardiothoracic centres. With the feminisation of the medical school intake, we are now seeing, across all surgical specialties, a decline in applications. In some geographic areas, applications (certainly to core surgical training) are failing to fill the posts available. Cardiothoracic surgery has always enjoyed a high ratio of applications to posts available and this does continue to some extent, particularly at the ST1 level. However, we should not be complacent and an active programme of attracting bright individuals from medical school into the specialty should be maintained.

With the help of the junior representatives on the SAC, attendance has increased at events both at the national (such as the Royal Society of Medicine careers fair) and regional level. In addition, the SCTS annual meeting has a separate section for medical student posters, which are assessed separately and for which a prize is awarded every year. In some medical schools, fourth-year medical students undergo a special study module; this is another way of exposing medical students to the specialty, which would not normally occur.

Curriculum

The ISCP has been around for almost ten years. With the curriculum becoming more mature over this time, we are beginning to see good results at the annual review of competence progression, enabling higher surgical trainees to stay on the straight and narrow with workplace-based assessments and operative logbooks. A recurring feature in the past five years has been how much of a mixed practice surgeons should do while they are in training. This has been superseded by changes at consultant recruitment and there will be no mixed practice posts from 2018. In fact, as far back as 2010, the SAC was pointing out to trainees that cardiothoracic posts were going to be limited, even at that stage, to perhaps no more than six hospitals in the country.

A meeting was held on 9 November 2014 between the Chair of the SAC for Cardiothoracic Surgery (Mr Sion Barnard), the GMC’s Director of Education and Standards (Dr Vicky Osgood) and the Chair of the Cardiothoracic Intercollegiate Exam Board (Mr Jon Anderson). There was some agreement that the specialty could split into cardiac surgery and thoracic surgery, and it was understood tacitly that one year should be spent training in the non-career intended specialty and five years in the career intended specialty (e.g., cardiac surgeons would do one year of thoracic training, presumably in their first year or two, and the remaining five years in cardiac surgery).

This is still to be finalised, particularly with the GMC, and it does go against the grain of the Shape Of Training review. When curriculum change is agreed, a change to the exam can be made to reflect this. It is then likely that there would be an oral examination at a higher level than at present in either cardiac surgery or thoracic surgery with some common questions at part 1.

National selection

The SAC has run national selection for eight years and we are starting to see trainees from the first intake (2008 entry) getting a consultant post. In the last three years, following a fact finding exercise with the neurosurgeons (who have had a run-through ST1 entry since 2008), the SAC for cardiothoracic surgery has piloted its own ST1 entry programme. The first group from the pilot (appointed to ST1 posts in 2013) should be moving into ST3 in August 2015. Although there were some who were wary of committing to a specialty such as cardiothoracic surgery so early in their career, the quality of the applicants and the number of the applications have been very high. As a result, the programme has been extended to the 2016 intake, at least.

National selection for cardiothoracic surgery has changed slightly over the years to reflect the logistics of running such a process, in parallel with other surgical specialties who are also running national selection programmes. While the SAC has adopted new formats, it has also tried to keep the changes to a minimum so that comparisons can be made across the years (e.g. seeing whether there has been any decline in the quality of the applicants).

The next chapter (Becoming a cardiothoracic surgeon) deals with national recruitment in more detail.

Sub-specialisation

Congenital cardiac surgery has a GMC recognised qualification and the only entry into this sub-specialty has been through a two-year programme (at ST7 and ST8), traditionally a rotation between Great Ormond Street Hospital and Birmingham Children’s Hospital. It has always been felt that the number of programmes should expand to allow more centres, with an excellent training background, to participate in training the congenital cardiac surgeons of the future.

In 2015 there will be ST7 entry into congenital cardiothoracic surgery, by numbered trainees into a rotational programme between Freeman Hospital in Newcastle and Alder Hey Children’s Hospital in Liverpool, and between St Thomas’ Hospital and Brompton Hospital in London. Sub-specialisation in adult acquired surgery (thoracic and cardiac) is not developed to the same extent although there are peri-CCT fellowships, funded by Ethicon, which have boosted trainees’ expertise in their final years before consultancy, giving them an opportunity to sub-specialise in, for example, mitral repair surgery and thoracoscopic lobectomy.

The specialist exam

The specialist exam for cardiothoracic surgery has undergone minor changes over the years in line with the general regulations from the Joint Committee on Intercollegiate Examinations. As mentioned above, there may be changes to the exam involving more intense scrutiny of trainees and their chosen sub-specialty (adult thoracic or adult cardiac surgery). This will be introduced subject to GMC approval and curriculum change.
Peri-CCT fellowships

These have enabled a small group of senior trainees to go into sub-specialty training to become more expert at sub-specialty aspects of cardiothoracic surgery. There is a formal peri-CCT fellowship in transplantation run currently between Papworth Hospital in Cambridge and Freeman Hospital in Newcastle, the trainee training in either of these centres rather than rotating (such as in the congenital cardiac surgery fellowships), and this is producing competent transplant surgeons at the end of their training who almost always go on to a consultant post elsewhere in the country. It is expected that the format of this fellowship will continue. It is run by the Wessex Deanery, as is the national selection process for cardiothoracic surgery. Ethicon funds, on average, two fellowships a year and this is likely to continue, at least in the short term. The fellowships are fought for competitively. They generally last six months and are usually taken abroad.

Professional development

Although the SAC is concerned with training, it has been keen to work with its industry partner, Ethicon, to ensure that trainees are exposed in their final years of training to the professional and managerial skills they will need as consultants. As part of the SCTS/SAC programme of approved courses through the ST3–8 years, the final year includes the Birmingham course on professional development. In the future, it may be that the SAC needs to take a more active role in post-CCT training and professional development in the early years of consultancy even though that is currently not the SAC’s remit.
Becoming a cardiothoracic surgeon

Junior surgeons

As in most specialties, junior surgeons at registrar level in cardiothoracic units may hold NTNs or not. Those who do not may yet aspire to an NTN or pursue a parallel path on to the specialist register through the GMC’s CESR route. Such junior team members hold posts named variously as trust doctors, trust fellows, clinical fellows or specialty doctors.

NTNs and national recruitment

There are currently 131 NTN holders in the UK. Until 2008 acquisition of an NTN was by competitive interview at training centres around the UK. An individual candidate might therefore have expended considerable time travelling from one interview to another until eventual attrition led to abandonment of this entry portal. Similarly, from the point of view of the NHS, this was a highly inefficient and costly process. There was also considerable inconsistency, a potential for bias and a general feeling of non-transparency in this old-style process.

Instead, the SAC invited applications for trainees from the regional training programme directors (TPDs). This enabled collection of unit specific data regarding training capacity, workload, trainers’ credentials and training quality, which fed directly into the SAC’s quality assurance report provided to the GMC each year. With limited places for training, after a three-year period of non-recruitment, training rotations were awarded trainee numbers on a competitive basis, decided by the members of the SAC, who used a scoring system based on the merits of the applications.

At the same time, aspiring trainees were invited to apply centrally for NTN positions at ST3 level. This was organised through the West Midlands Deanery, based in Birmingham, until 2011, when the Wessex Deanery took over. Shortlisting of hardcopy applications was performed by the TPDs. Their attendance was required in Birmingham for the process and each application was scored by three independent assessors. The shortlisting method was highly unpopular with TPDs. With a need to maintain enthusiasm for the national recruitment model, shortlisting was moved to an online, self-scored system that required no TPD input whatsoever. Shortlisted candidates were then invited to attend a multi-faceted interview process, which initially took place over two and a half days. This has now been shortened to a two-day event, run alongside ST1 recruitment, about which more will be written below.

The application form

Application numbers for ST3 entry have declined steadily since national recruitment began. For 2015 entry, there were 68 applicants for 13 NTNs, compared with as many as 130 applicants in years past. The number of posts available has fluctuated from a complete absence between 2004 and 2007 to a maximum of over 20 in recent years. A self-assessment application form encompasses a matrix in which operative experience is weighted against time spent in the specialty. Although controversial, this has also been adopted by other specialties who (like us) are trying to encourage applications from ‘fast track’ candidates. Such applicants have convinced their trainers to support them in acquiring surgical skills and experience at an early stage in their careers, thereby demonstrating a commitment to the specialty and an ability to inspire their trainer’s confidence in them.

The person specifications and self-scoring assessment forms can be found at:


The interview

The cut-off point for selection to interview has been decided by the number of NTNs to be awarded and the logistics of running a multi-station interview process. For 2015 entry, 13 posts were awarded at ST3 level. Forty candidates were invited to interview, equating to a ratio of three candidates for each post available. The interviews are held in Southampton, in late February.

ST3 candidates pass through a portfolio station at which the validity of their application forms will be checked. Candidates also face a situational judgement/structured questions interview before passing on to a communications station and a set of three stations for objective structured assessment of technical skills (assessing hand–eye coordination, knot tying and suturing skills).

Assessment is run very much along the lines of the intercollegiate clinical exam with pairs of assessors marking independently. Lay members of the panel circulate throughout the process, ensuring fair play all round and being available for discussion with any candidates as required.

The “wash up”

... is no more! Until 2013 the interview process culminated in a meeting of assessors at which the candidates’ scores were reviewed and a ‘cut point for appointment’ was decided. This was open to bias and was dropped in 2014. Instead, last year’s NTNs were appointed purely according to ranking in the interview process, up to the number of training places available. This process was managed by the recruitment team at the Wessex Deanery as assessors and candidates made their way home. Successful candidates were alloted to training rotations according to their ranked preferences, with the highest scoring candidates being the most likely to achieve their first choice of location.
ST1 entry portal

It was increasingly felt by the SAC that cardiothoracic surgery has been missing out on the best UK medical school graduates by restricting recruitment to the ST3 portal. After comparison with neurosurgery, which has been recruiting primarily through ST1 for several years, the SAC for cardiothoracic surgery decided in 2013 to run a pilot of eight ST1 NTNs, recruited along very similar lines to those for ST3. Another eight NTNs were awarded in 2014 and, to date, not one trainee has dropped out of the training programme. The pilot therefore seems to have been a success.

With this in mind, training rotations were invited to bid for eight further ST1 NTNs this year. Sadly, only five posts were requested. The drop in numbers is most likely due to a coincidental squeeze on core training posts, which has hit cardiothoracic surgery disproportionately hard. This is a shame considering the high level of interest shown in the specialty. Similar to the first two years, in 2015 there were 68 applicants for these 5 posts, the majority from UK medical school graduates. Many of the applications were of a very high quality. It remains to be seen whether unsuccessful candidates will stay interested in the specialty and apply again through the ST3 portal.

The real test will come when the first cohort of ST1 entry trainees passes through into cardiothoracic ST3 training. They will have the choice, prior to this, to take their generic core competencies gained in ST1 and ST2 into other surgical specialties recruiting at ST3 level. In contrast, in neurosurgical training, ST1 and ST2 training competencies are not generic. A trainee choosing neurosurgery at ST1 is therefore fully committed to continuing in that specialty through to award of the CCT. As a testament to their recruitment process, neurosurgery has a very low dropout rate through the course of training, suggesting that surgical trainees are perfectly capable of making their career choices at an early stage.

Current training status

As of January 2015, across the UK, there are 131 trainees holding NTNs. Their distribution between the training rotations is given in Table 8. Actual numbers vary month by month as trainees gain consultant positions and resign their NTNs. Consequently, numbers in the right-hand column do not represent training capacity.

### Table 8

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Number of NTNs</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>29</td>
</tr>
<tr>
<td>North West</td>
<td>15</td>
</tr>
<tr>
<td>West Midlands</td>
<td>13</td>
</tr>
<tr>
<td>East of England</td>
<td>12</td>
</tr>
<tr>
<td>Wessex</td>
<td>11</td>
</tr>
<tr>
<td>North East</td>
<td>10</td>
</tr>
<tr>
<td>South West</td>
<td>9</td>
</tr>
<tr>
<td>Yorkshire/Humber</td>
<td>8</td>
</tr>
<tr>
<td>East Midlands</td>
<td>6</td>
</tr>
<tr>
<td>Wales</td>
<td>6</td>
</tr>
<tr>
<td>Scotland</td>
<td>8</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>131</strong></td>
</tr>
</tbody>
</table>

Some of these training numbers are academic posts, appointed alongside regular NTNs, to candidates who have been successful, first, at NTN interview. This has safeguarded the possibility for trainees who leave academic posts for one reason or another to legitimately take up standard NTN posts to complete their training.

Sub-specialty training

Training in transplantation and paediatric cardiac surgery is evolving. Paediatric cardiac surgery is now recognised as a sub-specialty by the GMC. Units wishing to train paediatric cardiac surgeons have been invited to pair up and submit training bids. This has resulted in two potential appointments this year. These posts will be appointed at ST7, alongside national recruitment in the Wessex Deanery. The finer points of eligibility are being worked through by the SAC as there is a potential for difficulty if applicants for these posts are expected to hold the part 3 intercollegiate exam even though they cannot sit the exam until completion of their ST6 annual review of competence progression.

Summary

Overall, the level of interest in a career in cardiothoracic surgery remains healthy and the level of applications from highflying UK medical graduates to ST1 is particularly encouraging. The success of the ST1 pilot is yet to be defined but early indications suggest that it should be sustained and expanded. Training in paediatric cardiac surgery is being refined, and there is still work to do in developing training in heart and lung transplantation. Interest among trainees in academic posts remains reasonable although conflicts between adequate research time and time in surgical training continue to be as problematic as ever.
Cardiothoracic trauma

Background

Major trauma is the leading cause of death in people under 40 years of age and it has been recognised as a serious public health problem. There are at least 20,000 cases of major trauma each year (16,000 are among those aged under 40) with 5,400 deaths as a result. In addition, there are 28,000 more trauma cases that do not fit the precise definition of major trauma but require similar treatment and care. Chest trauma is responsible for approximately 25% of trauma deaths and is a factor in a further 25%.

With the introduction of regional trauma networks and major trauma centres in April 2012, the management of trauma in the UK has undergone a revolution. In July 2014 an independent audit produced by the Trauma Audit and Research Network showed that patients in England had a 30% better chance of survival than in 2012 (600 lives saved).

Trauma: Who Cares? (National Confidential Enquiry into Patient Outcome and Death, 2007) and Major Trauma Care in England (National Audit Office, 2010) recognised the poor treatment of these patients with limited regional organisation and the lack of consultant-led services. Many of the trauma related deaths were felt to be preventable with systematic improvements to the delivery of major trauma care.

Standards

The major trauma service specification D15 (http://www.england.nhs.uk/wp-content/uploads/2014/04/d15-major-trauma-0414.pdf) describes the facilities and specialties required by a major trauma centre, such as round-the-clock availability of a trauma team including a consultant and the ability to perform resuscitative thoracotomy in the emergency department. Consultant cardiothoracic surgeons must be available on site within 30 minutes. Major trauma centres are to have certain co-located services, one of which is cardiothoracic surgery. In terms of cardiothoracic equipment, the only absolute requirement is that a surgical tray suitable for resuscitative thoracotomy must be in the emergency department.

The National Peer Review Programme: Major Trauma Measures document (November 2014) states that there should be network agreed clinical guidelines for resuscitative thoracotomy, penetrating cardiac injuries, chest drain insertion and analgesia for chest trauma with rib fractures. Furthermore, where there are national guidelines, these should be included in the protocol. An endovascular stenting service for aortic injury should be available 24 hours a day. The treatment of traumatic disruption of the aorta is increasingly by endovascular stenting as opposed to open surgery.

Limitation of Standards

Although it is implied that it is the trauma team rather than the on-call cardiothoracic surgeon that should have the ability to perform resuscitative thoracotomy, this is not clearly specified. It is also not clear how the members of the emergency department team will develop and maintain this skill if they work in departments where this is required infrequently. However, this could though achieved through a combination of trauma skills courses such as the Definitive Surgical Trauma Skills course (Royal College of Surgeons of England) as well as teaching and training provided by trauma and cardiothoracic surgeons.

Recent developments in cardiothoracic trauma care

NICE has said that the use of rib fixation for treatment of flail chest may be used provided that normal arrangements are in place for clinical governance, consent, and audit. There is increasing use of rib fixation but the total number of cases performed each year is not clear. This treatment is undertaken by both cardiothoracic, and trauma and orthopaedic surgeons.

Training

Although the ISCP defines the objectives that trainees have to meet with respect to cardiothoracic trauma, it is also clearly stated that full competence in the operative management of complex cases, including great vessel injury, is to be developed in the post-CCT period. This recognises the sporadic and variable nature of trauma, exposure to which may be minimal on some training programmes.

Distribution of Major Trauma Centres

Adult and children’s major trauma centres

Addenbrooke’s Hospital, Cambridge
Frenchay Hospital, Bristol
James Cook University Hospital, Middlesbrough
John Radcliffe Hospital, Oxford
King’s College Hospital, London
Leeds General Infirmary
Queen’s Medical Centre, Nottingham
Royal London Hospital
Royal Victoria Infirmary, Newcastle
St Mary’s Hospital, London
St George’s Hospital, London
Southampton General Hospital

Adult major trauma centres

Demford Hospital, Plymouth
Hull Royal Infirmary
Northern General Hospital, Sheffield
Queen Elizabeth Hospital Birmingham
Royal Preston Hospital
Royal Sussex County Hospital, Brighton
University Hospital, Coventry
Royal Stoke University Hospital, Stoke-on-Trent

SAC and SCTS. Cardiothoracic Surgery. UK Workforce Report 2015

37
Children’s major trauma centres
Alder Hey Children's Hospital, Liverpool
Birmingham Children’s Hospital
Royal Manchester Children's Hospital
Sheffield Children's Hospital

Collaborative major trauma centres
For the regions below, trauma care is presently shared across a number of sites.

Manchester:
• Salford Royal Hospital
• Manchester Royal Infirmary
• Wythenshawe Hospital

Liverpool:
• Aintree University Hospital
• Walton Centre
• Royal Liverpool University Hospital

Of all the above centres, the following do not have on-site cardiothoracic surgery:
• Addenbrooke’s Hospital, Cambridge (although this will change when Papworth Hospital relocates)
• Frenchay Hospital, Bristol
• Royal London Hospital
• St Mary’s Hospital, London
• Royal Preston Hospital
• Royal Manchester Children’s Hospital
• Sheffield Children’s Hospital
• Salford Royal Hospital
• Aintree University Hospital, Liverpool
• Walton Centre, Liverpool
• Royal Liverpool University Hospital

Consultant job plans
The amount of cardiothoracic trauma work undertaken by units and surgeons depends on a number of factors. These include whether the cardiothoracic department is in a hospital that has a major trauma centre (or is co-located with one), a trauma unit, an accident department or none of these as well as internal working arrangements. The volume and type of chest trauma varies considerably from centre to centre on a geographical basis. The majority of penetrating trauma is confined to the largest cities. The work undertaken by an individual surgeon is covered in the unpredictable on-call section of the consultant surgeon's job plan.

Outstanding issues
The SCTS has approached Professor Chris Moran, National Clinical Director for Trauma for NHS England, regarding the provision of chest trauma care. The SCTS has been asked to contribute to the review and development of guidelines for the management of chest wall trauma, penetrating torso trauma and trauma care of the elderly (which is an increasing population).

Summary
The majority of cardiothoracic departments in the UK do not currently have consultant job plans that recognise a formal involvement with major trauma patients. It is anticipated that the care of patients with chest trauma will be largely absorbed by the existing number of consultant cardiothoracic surgeons. There may be some increased local service requirements in units where a major trauma centre is immediately co-located with a department of cardiothoracic surgery. The clear definition and development of standards for the management of chest trauma will inform the need for cardiothoracic surgical involvement and workforce requirements in the future but it is not anticipated that this will significantly influence the number of cardiac and thoracic surgical consultants recruited in the next five years.
Contributors

Editor:
Mr Simon Kendall
Honorary Secretary, SCTS
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, James Cook University Hospital, Middlesbrough

Chapter authors:

Foreword
Mr Simon Kendall
Honorary Secretary, SCTS
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, James Cook University Hospital, Middlesbrough

Executive summary
Mr Sion Barnard
Chair, SAC for Cardiothoracic Surgery
Consultant Surgeon, Freeman Hospital, Newcastle

Mr Tim Graham
President, SCTS
Consultant Surgeon, Queen Elizabeth Hospital Birmingham

Adult cardiac surgery
Mr David Jenkins
Chair, SCTS Adult Cardiac Surgery Committee
Chair, SCTS Clinical Audit Committee
Consultant Surgeon, Papworth Hospital, Cambridge

Mr Simon Kendall
Honorary Secretary, SCTS
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, James Cook University Hospital, Middlesbrough

Thoracic surgery
Mr Richard Page
Chair, Thoracic Surgery Clinical Reference Group
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Liverpool Heart and Chest Hospital

Mr Rajesh Shah
Education Secretary, SCTS
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Wythenshawe Hospital, Manchester

Mixed practice cardiothoracic surgery
Mr Jon Anderson
Chair, Cardiothoracic Intercollegiate Exam Board
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Hammersmith Hospital, London

Mr Mike Cowan
Consultant Surgeon, Castle Hill Hospital, Hull
Training Programme Director for Cardiothoracic Surgery, Yorkshire Deanery

Congenital cardiac surgery
Mr David Barron
Chair, SCTS Congenital Cardiac Surgery Committee
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Birmingham Children's Hospital

Mr Lars Nolke
Consultant Surgeon, Mater Misericordiae University Hospital, Dublin

Cardiopulmonary transplantation
Professor Stephen Clark
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Freeman Hospital, Newcastle

Mr Aaron Ranasinghe
Consultant Surgeon, Queen Elizabeth Hospital Birmingham

Academic cardiothoracic surgery
Professor John Dark
Consultant Surgeon, Freeman Hospital, Newcastle

Professor Gavin Murphy
Consultant Surgeon, Glenfield Hospital, Leicester

Training the future workforce
Mr Sion Barnard
Chair, SAC for Cardiothoracic Surgery
Consultant Surgeon, Freeman Hospital, Newcastle

Mr Steve Livesey
Previous Chair, SAC for Cardiothoracic Surgery
Consultant Surgeon, Southampton General Hospital

Becoming a cardiothoracic surgeon
Mr Jonathan Unsworth-White
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Derriford Hospital, Plymouth

Cardiothoracic trauma
Mr Stephen Rooney
Member, SAC for Cardiothoracic Surgery
Consultant Surgeon, Queen Elizabeth Hospital Birmingham

Mr Richard Steyn
Consultant Surgeon, Heartlands Hospital, Birmingham