Surgery in the United Kingdom has been practiced for nearly 2000 years. It has evolved as a result of the experiences of warfare and the introduction of the scientific basis of surgery. The influence of the 4 surgical royal colleges in setting standards for training and examinations has ensured that new surgeons are equipped for independent practice as consultants. Responsibility for the National Health Service rests with the government, which determines the number of trainee surgeons in the various surgical specialties. Conflicts between service provision and training are highlighted, as are the pressures on academic institutions to meet the demands of clinical surgery. The government’s National Health Service plan for England promises a major expansion in undergraduate places and an increase of 7500 consultants in all specialties by 2004. Time will tell if these changes lead to an improvement in surgical services and a reduction in waiting times.

Surgery in the United Kingdom (UK) is largely provided through the National Health Service (NHS), a system of health care that has been in existence for more than 50 years. It is estimated that 12 million (20%) of the 59.5 million people in the UK seek some form of private treatment annually, but only 7 million (12%) are covered by medical insurance. Private hospitals rarely provide emergency service, which is almost exclusively provided by the NHS.

HISTORY

Early evidence of surgery in Great Britain is recorded after the arrival of Claudius in 43 AD. Surgical instruments1 2 that were recently discovered during an archaeological excavation in a Roman doctor’s house in Colchester (the oldest recorded Roman town in England) (Figure 1) resemble the instruments used in ancient Egypt (Figure 2). In 1216, a papal edict required that priests not practice surgery lest they shed blood. Consequently, surgery passed from priests to barbers, the more skilled of whom became known as surgeons and were referred to as “leeches.” In London in 1300, a Fellowship of Surgeons was established to assess and accredit surgeons. War between England and France during the next 200 years brought about the emergence of the surgeon as a vital part of the King’s Army. In 1540, formal recognition of surgeons was provided by King Henry VIII, who granted a royal charter that amalgamated the Company of Barbers and the Fellowship of Surgeons. Two hundred years later, in 1745, the surgeons separated from the barbers, and in 1800 they established the Royal College of Surgeons in London. In Scotland, a college was established in Edinburgh as early as 1505, and it became a royal college in 1778. In Glasgow, a faculty of physicians and surgeons was established in 1599, but it did not become a royal college until 1962. The Royal College of Surgeons in Ireland was established in Dublin in 1784, while Ireland was still under British rule.

From the Department of Surgery, Basildon, Essex (Dr Ribeiro); Museums of the Royal College of Surgeons of England, London (Mr Chaplin); Department of Surgery, North Tees Hospital, Stockton-on-Tees (Dr Peel); Department of Surgery, St Thomas’ and Guys Hospital, London (Dr Treasure); Department of Oral and Maxillofacial Surgery, North Staffordshire Hospital, Stoke-on-Trent (Dr Leopard); and the Royal College of Surgeons of England (past president) and St Thomas’ and Guys Hospital (emeritus consultant) (Dr Jackson), England.
Avid readers of histories of surgery might be forgiven for concurring with Thomas Carlyle that history “is but the biography of great men.” The roll of honor for British surgery is well known—John of Arderne in the 14th century; John Hunter, William Cheselden, and Percival Pott in the 18th century; Astley Cooper, Robert Liston, and Joseph Lister in the 19th century; and Frederick Treves, Robert Jones, Henry Souttar, Harold D. Gillies, Russell C. Brock, and John Charnley in the 20th century. As the field of surgery has grown broader, so too have burgeoning specialties produced their own pioneers—far more than can be given credit in this summary.

British surgeons claim John Hunter (1728-1793) as the founding father of scientific surgery. In the 19th century, the establishment of new medical schools and universities helped to provide a new class of qualified surgical practitioners. Regulation eroded the status of unqualified practitioners, and the growth of charitable hospitals enabled a far larger proportion of the population to have access to professional surgical treatment. These new institutions also fostered the application of scientific research to surgery, and the slow rise of specialist hospitals fostered the development of areas of surgery such as ophthalmology, otolaryngology, orthopedics, and pediatric surgery. However, the confidence of surgeons was not always reflected in patient outcome: thus, the use of antiseptics to control infection proved hopelessly ineffective amid the mud of the Western Front of World War I, and mortality for appendectomy was as high as 20% well into the 1940s. As with earlier conflicts, the catastrophic global wars of the 20th century resulted in improvements in surgery and allied sciences. Treatment of battle injuries led to major innovations in plastic and orthopedic surgery in both wars, and penicillin and blood transfusion were to become widely used during World War II. Wartime mobilization of resources, particularly the “Blood for Britain” campaign launched by American Charles Drew, provided surgeons with the means to resuscitate seriously injured frontline troops and to prevent postoperative infection.

In the postwar period, surgery continued to benefit from the massive investment in scientific research during the 1940s and later during the Cold War. Ultrasound, computerized tomography, and magnetic resonance imaging all have their roots in military research, and research in immunology, biochemistry, and materials science have helped to underpin advances in surgical practice.

SURGICAL EDUCATION AND TRAINING

The surgical royal colleges have a statutory function to oversee the training of surgeons and their assessment by examination. In recent years there has been considerable emphasis on the education of surgeons. The 4 royal colleges are linked with the various specialty surgical associations through the Senate of Surgery, a surgical forum that has an advisory rather than an executive role.

Entry into the European Economic Community resulted in the UK adopting the definition of a specialist as defined in Europe. Training comprises 2 years of basic surgical training (BST) followed by 6 years of higher surgical training (HST). During this time, 2 examinations are taken: the MRCS (Membership of the Royal College of Surgeons) at the completion of BST and the specialty FRCS (Fellowship of the Royal College of Surgeons) toward the end of HST. A certificate of completion of specialist training is awarded, and the specialist, now aged 34 to 38 years, is eligible to apply in open competition for a UK (NHS) consultant post or to move to another European Union member state. This 8-year training period is considerably shorter than in the past, when train-
Basic Surgical Training

To enter a BST program, the beginning surgeon must complete an intern year or possess a recognized qualification obtained in the European Union or elsewhere. Basic surgical training requires 2 years in educational posts approved by the royal colleges, with 12 months spent in 2 different specialties, each with a significant component of surgical emergencies requiring general patient care and care of the critically ill, eg, general surgery, orthopedics, or accident and emergency. The remaining 12 months is spent in other specialties, either two 6-month posts or three 4-month posts. In all, the trainee must experience 3 separate surgical specialties with no more than 6 months in any one specialty. There is a mandatory basic surgical skills course and a voluntary advanced trauma life support course and a care of the critically ill surgical patient course. The trainee keeps a log in which operations are recorded, with a note as to whether the trainee was an assistant, performed the surgery under supervision, or performed the surgery independently. This log also records complications.

Training is controlled by the training boards of the royal colleges, which devolve responsibility to surgical tutors and regional advisors, who in turn liaise with the postgraduate deans. The training boards report to the Specialist Training Authority, which is composed of representatives of all the medical royal colleges in the UK, the faculties of public health and occupational medicine, the General Medical Council, the postgraduate deanship, NHS management, and patients. The Specialist Training Authority has legal responsibility for the standards of postgraduate medical training in hospital practice in the UK and supports and formalizes the process whereby the colleges and faculties have responsibility for deciding the content of training and the standards to be achieved. The individual colleges are responsible for the syllabuses.

The royal colleges play an important role in education. In 1994, the Royal College of Surgeons of England launched the first distance learning course for the FRCS Part II (Clinical Surgery in General), known as the Surgeons in Training Education Programme (STEP). This has now been adapted for the new MRCs diploma. The MRCs syllabus differs from the old-style FRCS syllabus because the period of training is 2 years compared with 4 years, but the royal colleges still insist on a strong component for basic science in the MRCs program. The merits of the distance learning course are that a common, consistent standard is achieved and maintained and the method whereby the trainee obtains knowledge is more acceptable and enjoyable, with a considerable interactive component. With the advent of modern technology, the electronic STEP (e-STEP) course has been developed, which increases flexibility, includes interactive exercises, and stresses the importance of basic scientific knowledge.

Before trainees can enter HST, they must pass the MRCS examination, which is taken in 3 parts and comprises 2 written papers of multiple-choice questions, a clinical examination, and a viva voce examination, all of which must be passed. Creation of the STEP course has resulted in a higher pass rate compared with the old-style FRCS, which is no longer examined by the English college (the Scottish and Irish colleges are discontinuing this examination in 2002). The MRCs marks the end of BST, and the specialty FRCS is now used to define completion in HST.

Higher Surgical Training

After completing BST, trainees compete for HST posts in 1 of 9 specialist areas (general surgery, orthopedics, neurosurgery, cardiothoracic surgery, otolaryngology, urology, plastic surgery, pediatric surgery, and oromaxillofacial surgery). Specialist advisory committees define the syllabi and are accountable to the Joint Committee for Higher Surgical Training, which in turn reports to the royal colleges via the Senate of Surgery. A quinquennial inspection of training posts by members of the specialist advisory committees is well established. At the end of 6 years of recognized training, a certificate of completion of specialist training is awarded provided the intercollegiate specialty FRCS examination has been passed.

Rotations through successive posts in the training program are produced by a program director in conjunction with the Regional Higher Surgical Training Committee—the equivalent of the Residency Review Committee in the United States.

The rotations are arranged so that the first 2 years include specialty-specific general content and the later years include training in more specialized units. The trainee then takes a specialty FRCS organized on an intercollegiate basis in 1 of the 9 specialist advisory committee–defined specialties.

The syllabuses for these examinations are set by an intercollegiate board for the appropriate specialty, with the examination comprising a clinical, a viva voce, and an assessment of the trainee’s ability to critically assess written articles in peer-reviewed journals. The written content varies according to specialty. Most training is provided by consultants in the regions, but the trainee is encouraged to attend various skills workshops at one of the royal colleges.

RESEARCH, DEVELOPMENT, AND AUDIT

British medical schools all have an academic department of surgery to lead the teaching and the examination of undergraduates. The university appoints the head of the department, titled professor of surgery, who by convention is a general surgeon, although each has a specialist practice such as upper or lower gastrointestinal surgery, vascular surgery, endocrine surgery, or breast surgery. Tenured surgical staff within these departments are called senior lecturers and are equivalent in clinical status to consultant surgeons within NHS hospitals. In parallel, NHS surgeons working in teaching hospitals are often given the title of honorary senior lecturer in recognition of their role in teaching medical students. A few university-employed surgeons are awarded the title of professor on an ad hoc basis.
To a variable degree, individual professors and senior lecturers undertake original clinical and/or animal laboratory research. They attract young surgeons in training to the academic department typically for 1 to 3 years. In the most competitive surgical disciplines, this period spent in research is essential for progress up the surgical ladder. Before the recent changes to specialist training, it was unusual for the transition from registrar to senior registrar to be made without a higher research degree. With the change to a continuum in higher specialist training, the research years are now taken earlier so as to occupy time between BST and HST. Market forces have tended to make it an entry requirement to the specialist training grade, which is not necessarily a good means of selecting future surgeons, training researchers, or expanding scientific knowledge.

In Britain, the degrees doctor of medicine and master of surgery are awarded by thesis. Surgeons working 3 to 4 years for a doctor of philosophy are uncommon, and such study is believed to be inappropriate except for those with the highest academic potential.

Core funding is derived from 2 sources. Medical schools give a service increment for teaching to hospitals that accept students for tuition to repay the time taken out of clinical practice by the hospital staff to participate in undergraduate teaching. For postgraduate output, the university research assessment exercise provides funding to academic departments in proportion to their research output judged by peer-reviewed publications weighted according to their impact factor. In practice, any significant research has to be funded by grant applications to national research funds, such as the Medical Research Council or various charitable organizations.

There are 24 medical schools in the UK, many of which are attached to university hospitals. Specialist academic units also exist in some university hospitals without medical schools. A great deal of surgical research and innovation in British surgery has been and continues to come from surgeons working outside any formal academic structure. In fact, it could be argued that the biggest research advances and surgical developments have not been made within formally constituted academic departments.

The tradition of research in British surgery has remained that of clinical research and seeking to model the disease and its treatment in the animal laboratory. It is based on the premise that the better you understand the mechanism of an illness, the more likely you are to effectively relieve it. This approach was ideal for the British surgical unit when the interventions were within the skills of the surgeon and the end points either were gross pathological changes or were relatively easily determined by microscopy or biochemistry. It is now questionable whether the 2 or 3 members of the staff of an academic unit can master research techniques in an era of molecular biology and at the same time meet the demands of clinical surgery.

AUDIT

British surgeons used survival data to compare outcomes more than 100 years ago. Spencer Wells (1818-1897), after whom the artery forceps are named, pointed out the much lower mortality rate after amputation of injured limbs in provincial hospitals compared with London teaching hospitals, where there was alarmingly high mortality of 50%, largely due to infection. Willingness to use audit data was deeply ingrained in the surgical culture long before audit became the NHS buzzword of the 1980s. Now, audit is built into every job description in the NHS.

The Audit Unit of the Royal College of Surgeons has been renamed the Clinical Effectiveness Unit. This unit provides audit based on a sound epidemiological and statistical basis.

Since 1976, the UK Cardiac Surgery Register has kept a near-complete account of all cardiac operations performed in the UK. The paradox is that the existence of apparently reliable audit data provided a comparison against which the Bristol surgeons were judged. It is little wonder that there is reluctance in some quarters to volunteer data for audit if they are to be used in this way. The profession provides all the audit data referred to voluntarily. It has now been agreed that all cardiothoracic surgeons will provide annual volume and mortality figures for coronary artery surgery, lobectomy for lung cancer, coarctation, and repair of congenital ventricular septal defect and that these figures will be available for NHS or General Medical Council purposes. The professional view is that government and NHS data are not always reliable. Increasingly, in a state-run health service, responsibility for clinical guidelines is being assumed by government agencies. The National Institute for Clinical Excellence is one such agency, whose guidance, based on outcomes and cost, might have the effect of limiting surgical practice.

In Scotland, the Scottish Inter-Collegiate Guidance Network was established in 1993 to sponsor and develop national guidelines on a multiprofessional basis. It incorporates levels of evidence similar to those used by the US Agency for Healthcare Research and Quality, and as such its recommendations have set a gold standard for clinical guidelines.

SURGICAL SOCIETIES AND SPECIALIZATION

Except for ophthalmology, surgery before World War I was practiced by general surgeons. The boundaries between what we now recognize as surgical specialties hardly existed, and although surgeons had their special interests, a consultant was expected to undertake the whole range of operative work. Whereas the royal colleges set and advise on the standards of surgical practice, the specialty associations and societies, which represent the specialist advisory committee–defined specialties (Table 1), make sure these standards are maintained through the organization of surgical meetings and workshops. The Senate of Surgery provides a forum for the 4 surgical royal colleges and specialty associations to meet, and with representatives of the Joint Committee for High Surgical Training and the Joint Committee for Inter-Collegiate Examinations can provide a unified voice for British surgery.

SURGICAL MANPOWER

In the UK, there are 63 recognized specialties, including the 9 surgical specialties, all of which (except for car-
dithoracic surgery) are recognized under the European Medical Directives. These directives stipulate a minimum duration of training for each specialty and permit free movement of specialists between member states.

The salary of trainee surgeons is divided equally between the employing hospitals and the postgraduate deans, there being 8 deaneries in England. In Scotland, the deans fund the entire salary. This arrangement recognizes the dual importance of education and service provision for surgical trainees.

Most specialists are employed in the grade of consultant in the NHS. Although consultants have the option of forfeiting 10% of their NHS salary to spend a limited amount of time in the independent sector, very few specialists choose full-time independent practice.

Workforce planning in the NHS is an inexact exercise carried out jointly by the government via the Department of Health and the profession via the royal colleges, the specialty associations, and the British Medical Association. The objective is to match the supply of trained specialists with the demand for consultants. The most significant difficulty is the 6-year lead-in time for training so that the response to match any likely increased or reduced demand is slow.

Factors Affecting Supply

1. The number of trainees in the generic pool, which feeds both general practice and specialist training.
2. Government spending on training placements, as announced in the annual public expenditure round.
3. The popularity of individual specialties—all the surgical specialties have many more aspiring applicants than placements available, whereas others (such as psychiatry and general practice) show the opposite trend.
4. The training capacity within a specialty in which rotational programs have to meet strict criteria imposed by the colleges.

Factors Affecting Demand

1. National initiatives, such as the need to reduce waiting times.
2. The perception of individual hospital’s required consultant numbers 6 years ahead.
3. The changing work patterns of consultants as a reflection of the trends to retire earlier, to work flexibly or part-time, and to meet the requirements of the European Working Time Directive, which will limit the hours worked by all.

4. The changing culture of integrated workforce planning whereby nurse specialists and some professions allied to medicine are equipping others to take on certain traditional roles of the physician.

5. The effect of greater specialization in surgery, which enhances the quality of care but threatens the maintenance of a generalist service, especially for emergency care.

6. The effect of the evolution of the surgical team as a corporate structure that is driven by the amalgamation of smaller hospitals into larger organizations and by the need to provide continuity of care in the face of reduced hours of work and escalation of the nonclinical duties of consultants.

Resolving the Equation “Supply = Demand”

Many individual factors that affect supply and demand are unquantifiable, and many are fragile because they cannot be achieved within a single term of government office.

Against this background, the Specialty Workforce Advisory Group, which has now been subsumed by the National Workforce Development Board and the Workforce Numbers Advisory Board, recommends to the government each year the numbers to enter specialist training in each of the 63 specialties. The tools available to the Specialty Workforce Advisory Group were various data from the existing workforce (Table 2), an annual workforce projection questionnaire cascaded to each hospital, annual meetings with representatives of each specialty, and limited knowledge of forthcoming government health initiatives. The Specialty Workforce Advisory Group applied a complicated formula in its consideration of each specialty and made recommendations to the government each year. Ministers then adjusted the figures depending on available money and on political grounds.

There are tensions and constraints each year owing to lack of government funding. Despite these tensions, the voice of surgery is influential, and for the past 6 years we have seen year on year expansion in the numbers of consultant surgeons (Table 3). This steady expansion...
is closing the gap between existing numbers of consultants and the target numbers advised by the surgical profession.

FUTURE DEVELOPMENT OF SURGERY

The government’s NHS Plan for England commits to an increase in undergraduate places of another 1000 in addition to last year’s 1000, which will lead to an output of 9000 physicians per year, an increase of 7500 consultants by 2004, and substantial increases in nursing staff. It also draws attention to the need to review the BST grade, as it is clear that currently only 1 in 5 trainees who have completed BST can progress to HST. The dilemma facing the profession is that it wishes to preserve the single equal grade of consultant in the NHS.

Consultant surgeons working in teams must be supported by a hierarchical structure of basic and specialist trainees, but inevitably the numbers in the training grades must be limited to match the number of consultant posts that will become available as a result of retirement or service expansion. The numbers are such that for teams to provide adequate elective and emergency care, employing hospitals have to recruit a range of “nonconsultant career grade” staff who are not trainees and who do not or cannot aspire to the consultant grade. Often from overseas, many of these surgeons perform a most useful role in undertaking a limited range of elective surgery and enabling hospitals to comply with the increasing constraints of the European Working Time Directive. The numbers of nonconsultant career grade staff are increasing at a much greater rate than consultant numbers, and many are likely to become frustrated at the lack of opportunity for career progression.

In the NHS, there are conflicting interests. For example, the provision of a consultant-led service might conflict with training, as training in an outpatient clinic or during an operative list requires time. Consequently, the throughput of work with respect to patient numbers tends to decrease. Government initiatives to reduce NHS surgical waiting lists further counteract a consultant’s ability to train. In the future, there might be a need to identify particular operating lists or clinics for training.

Currently, within surgery, there are difficulties in recruiting to breast and endocrine surgery and transplantation. Conversely, the subspecialties of upper and lower gastrointestinal tract surgery are producing too many trainees. Against this background, the government plans to provide an additional 1000 training numbers, in medicine and surgery, by 2004. The increase for surgery is shown in Table 4.

What is the role of women in surgery? Although approximately 60% of medical graduates are women, currently only 5% of the consultant workforce in surgery is female. With the flexible training and working opportunities now available, this is likely to reach 20% in the next 10 to 15 years. Opportunity Now—Creating the Right Balance, launched in September 1999, is a constructive national effort to ensure that the 20% target is reached by 2010.

Although strict manpower control in the UK has broadly matched supply with demand and has avoided unemployment, there has for too long been a dependence on overseas graduates. There is now a serious agenda for change—more physicians, more nurses, improved quality of care, and reduced working hours. The cost will be formidable; it remains to be seen what can be achieved and whether government is prepared to fund the change.

Table 3. Annual Rate of Consultant Expansion

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Annual Expansion, 1993-1999, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>General surgery</td>
<td>3.7</td>
</tr>
<tr>
<td>Trauma and orthopedics</td>
<td>5.0</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>1.1</td>
</tr>
<tr>
<td>Urology</td>
<td>6.8</td>
</tr>
<tr>
<td>Oral and maxillofacial surgery</td>
<td>1.3</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>5.9</td>
</tr>
<tr>
<td>Cardiothoracic surgery</td>
<td>3.4</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>4.3</td>
</tr>
<tr>
<td>Pediatric surgery</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Table 4. Additional National Training Numbers

<table>
<thead>
<tr>
<th>Specialty</th>
<th>2001-2002</th>
<th>2001-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>General surgery</td>
<td>+23</td>
<td>+86</td>
</tr>
<tr>
<td>Trauma and orthopedics</td>
<td>+10</td>
<td>+40</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>+10</td>
<td>+25</td>
</tr>
<tr>
<td>Urology</td>
<td>+5</td>
<td>+15</td>
</tr>
<tr>
<td>Oral and maxillofacial surgery</td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>0</td>
<td>+10</td>
</tr>
<tr>
<td>Cardiothoracic surgery</td>
<td>+25</td>
<td>+25</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>+2</td>
<td>+4</td>
</tr>
<tr>
<td>Pediatric surgery</td>
<td>0</td>
<td>+6</td>
</tr>
</tbody>
</table>

References