Chapter 2
Surgical Education: A Historical Perspective

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Overview This chapter considers how the landscape of surgical education has changed over the past century and how the educational certainties of an earlier generation have been supplanted by fluidity and instability. After outlining the establishment of open surgery in the first half of the twentieth century, the chapter uses the introduction of minimally invasive (keyhole) surgery in the 1980s as a lens for examining the educational implications of surgical innovation and the processes by which such innovation can trigger educational change. At the same time, the discussion charts the emergence of professionalism of surgical education, shaped by expert perspectives from outside medicine. This has led to a broadening of methodological approaches to the investigation of educational questions and the establishment of surgical education as a scholarly field with its own identity. The chapter concludes by reflecting on the continual process by which innovation becomes established as a 'new normal', only to be overtaken in its turn by continuing change.

This chapter surveys how the landscape of surgical education has changed over the past century and how contemporary challenges have been shaped by the past. In that time, the surgical world – together with the sociopolitical world it responds to and reflects – has become increasingly fluid and unstable. Disciplinary boundaries are becoming blurred, and new technologies are overturning previously settled ways of knowing and of doing. The focus of surgical education has shifted from learning how to do things as they are already done to responding to (and moulding) a surgical world that is in continual flux. A professionalisation of education has taken place which has moved beyond the frame of surgical practice to include expert perspectives from outside medicine. This has profound implications for what it means to be a surgeon and a surgical educator.

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Two related developments – keyhole (minimally invasive) surgery and simulation-based training – provide the backdrop for a discussion about changes which have shaped the landscape of today. This account will inevitably oversimplify a complex picture. It presents the personal perspective of the author, a clinician who trained as a surgeon in the 1970s and 1980s, became a general practitioner in the 1990s, and has since specialised in surgical education at a large London university medical school.

Surgery in its current form is rooted in the upheavals and discoveries of eighteenth-century Europe [1, 2]. At that time, Paris emerged as a major centre of clinical innovation, while in Britain, the Hunter brothers (John and William) played a pivotal role in establishing surgery as a scholarly discipline underpinned by rigorous study. Wherever it was practised, a strong performative element to operative surgery was prompted by the need (before the discovery of anaesthesia) for surgeons to be rapid and decisive and influenced by a history of anatomical and surgical performance reaching back to earlier centuries.

The next hundred years saw the establishment of 'scientific' surgery, influenced by European (and especially German) practice. Advances in microbiology and biochemistry transformed clinical practice, framing surgery as the application of scientific knowledge and surgeons as applied scientists rather than performers. From the mid-nineteenth century onwards, developments such as anaesthesia, antisepsis and asepsis meant that previously inaccessible territories of the body could be safely operated upon – first the abdomen, then the brain, the heart and beyond. Approaches to investigation, diagnosis and treatment became increasingly influenced by the laboratory, and the body became seen as a mechanism which could be fixed by surgery.

At the same time, major changes were taking place in the landscape of clinical education. Concerns about standards in American medical schools led to Abraham Flexner's overhaul of undergraduate medical training and brought much-needed reforms. His report of 1910 sets standards for admission and graduation, highlighting the importance of science in the curriculum [3]. This led to the closure of many rural medical schools in America and laid the foundation for educational structures which persist to this day. Postgraduate education too was in flux. For example, in the late nineteenth century, the celebrated surgeon William Halsted introduced the concept of a formal surgical residency at Johns Hopkins Hospital in Baltimore [4–6]. In a model which became widely adopted and is still in place today, structured training combined clinical experience with graded supervision.

In the United Kingdom, the establishment of the National Health Service in 1948 marked a later watershed. For the first time, medical care became available to all, regardless of the ability to pay. In the decades that followed, surgical care was provided within a strong social professional framework. A clear hierarchical structure (established in the aftermath of World War II and reflecting the social structures of the time) was set in place. Education and training were central to this structure. Surgical 'firms', each led by a consultant, consisted of close-knit groups of surgeons in training who underwent an extended apprenticeship lasting many years. Almost all out-of-hours care was provided by those in training, and trainees gained extensive

experience in operative surgery. The 'firm' system ensured continuity of care for patients and offered a supportive and collegiate milieu for clinicians but required high levels of commitment and exceptionally long hours of work. An important effect of this demanding training was to develop a surgical identity amongst those who underwent it – a shared sense of what it meant to 'be' a surgeon as well as to do surgical work, as much about who a surgeon became as what he or she could do. In contrast to undergraduate medical education, with its focus on curriculum and formal learning, postgraduate surgical learning was assumed more than designed or prescribed. Assessment of fitness to progress within the system was unsystematic, opaque and based on the personal judgment of senior clinicians.

By the mid-twentieth century, surgery seemed to have reached a steady state. A stable social structure for interaction between patients and professionals was taken for granted, and – as with education in schools and universities more generally – what was to be learned appeared fixed and unchanging. This approach represented the wider sociopolitical context of the time, with its climate of deference and confidence in authority in general and in the medical profession in particular. Publics and politicians trusted clinicians to design and oversee their own educational as well as clinical practice, and post-war social assumptions were clearly visible.

By this time, surgical training had become well-established, with education accepted as a by-product of clinical care. The assumption was that by working within the healthcare system for long enough, a learner would eventually become expert. The extended apprenticeship system provided enormous experience in the skills of operating, while the 'firm' structure ensured that trainee surgeons became versed in all aspects of patient care (including continuity between ward and theatre) and became part of a close-knit (if closed and often inward-looking) professional community. For surgeons, therefore, education and clinical care were inseparable. There were few specific courses or programmes, and surgical learning took place from within, as part of being a practitioner. Senior surgeons were expected to teach in every aspect of their practice, from outpatient clinic and ward to operating theatre and emergency room, but there was no overt surgical curriculum. Learning took place by absorption, underpinned by an assumption that by the end of training, trainees would have been exposed to sufficient breadth and depth of experience to undertake full responsibility when they became consultants themselves. Professional examinations were more about factual knowledge than practical skill.

By the 1980s, all this began to change. Part of this disruption was technological. Discoveries and developments in areas such as imaging, energy sources, fibre optics and miniaturisation led to new opportunities within operative surgery and medicine as a whole. The power of surgery (until then confined to what could be done with relatively simple instruments) became enormously enlarged. At the same time, a shift from diagnosis to intervention meant that previously sharp distinctions between surgery, medicine, radiology and other disciplines started to become smudged. Intestinal endoscopy, for example, was developed by gastroenterologists and radiologists, and surgeons were no longer the only group who carried out delicate invasive procedures on patients.

Another aspect of this disruption was societal, reflecting equally profound political and social change at that time. Public faith in the skill and beneficence of doctors began to be questioned, challenging previously stable structures of authority and deference. A series of prominent cases in the UK included the Bristol heart surgeons (where it became clear that some paediatric cardiac surgeons continued to operate on small children while knowing that their results were worse than those of colleagues), the Alder Hey Children's Hospital scandal (where pathologists removed and retained body parts without parents' knowledge or consent) and the notorious Dr. Harold Shipman (who systematically murdered scores of patients). These and others started to erode the unquestioning trust of an earlier generation, reconfiguring relationships between clinicians, patients and society. Management structures within the health service were redesigned too, and clinical practice was no longer the exclusive province of clinicians. Clinical education too came under the microscope, and educational practice began to open up to specialist non-clinicians.

What became known as keyhole surgery provides a useful example of how technical innovation, public perception and a changing sociopolitical climate collectively precipitated educational change. This change was shockingly rapid. If it is difficult for trainees starting a surgical career today to envisage a world before minimally invasive surgery, it is perhaps even more difficult to imagine a world without the Internet, mobile phones or word processors. In the mid-1980s, none of these things were there. Yet within a single surgical generation, a radical new approach to operative surgery became embedded as the 'new normal'.

Keyhole surgery can be seen as a watershed in many ways. In surgical terms, it transformed perceptions of the need for surgery to be invasive, demonstrating that major interventions could be carried out through tiny incisions which dramatically reduced pain and shortened hospital stays. In social terms, it marked a shift in the balance of power between the profession and the public, showing how pressure from patients accelerated the adoption of a new approach [7]. In educational terms, it highlighted how a radical change in surgical practice (apparently a technical issue) continues to reverberate through surgical training.

The meteoric rise of keyhole surgery is instructive. In the 1980s, a number of clinicians were exploring how to minimise the trauma of open surgery, with its extensive incisions. Taking advantage of technical developments of the time (including advances in imaging, energy sources and fibre-optic technology), they developed innovative ways of collaborative working in order to solve technical challenges. The urologist John Wickham, for example, pioneered percutaneous nephrolithotomy for the removal of renal tract stones. Working closely with an interventional radiologist, instrument designer and other clinical colleagues, Wickham made a major contribution to what has now become a commonplace procedure. In the process, he modelled a new surgical approach, challenging the dominant role of the surgeon and suggesting instead that power be distributed within a surgical team to draw on multiple sources of expertise. The author has researched this process in detail, gathering first-hand accounts of a transformative time by using simulation-based re-enactment to document not only technical developments but relationships with patients and within clinical teams [8–10].

As surgery's power increased, so did its potential for causing harm. Once the benefits of minimally invasive therapy (as Wickham named it) started to become known, pressure from patients mounted for surgeons to perform procedures laparoscopically. A series of high-profile disasters raised public awareness of the dangers of the new surgery in inexpert hands. Iatrogenic damage during elective laparoscopic surgery showed that specific training was needed, even (perhaps especially) for experienced surgeons who had acquired great expertise in open surgery but struggled with making the transition to a different paradigm.

This posed an educational challenge. The manipulation of keyhole instruments required qualities which were not guaranteed by seniority and expertise in open surgery but required specific aptitudes, training and experience. The physical challenges of manipulating tissues and materials at a distance using unfamiliar instruments, viewed via screen-based images rather than direct vision, demanded unfamiliar perceptual and fine motor skills. The 'new surgery' was new for all surgeons and levelled the playing field. This triggered a systematic approach to learning these unfamiliar ways of seeing and doing. Because keyhole surgery was revolutionary rather than evolutionary, it became easier to make the case that all surgeons (not just beginners) needed formal training. There was no shame in a surgeon admitting that he or she was not an expert in this radically new approach (unlike admitting to uncertainty in a field in which they were already regarded as expert). The established approach of learning from seniors who had mastered what learners aspired to learn did not hold when the masters themselves were on uncertain ground. There was a need instead for education based on meeting the demands of the new rather than absorbing the ways of the old. Training courses multiplied and assessment took centre stage.

The requirement for specialised motor skills brought a new emphasis on technical aspects of surgery. A distinction between 'technical' and 'non-technical' skills arose, raising issues about how fine manipulative skills in particular might be taught, learned and assessed. 'Skills laboratories' were established, where surgeons could practise and perfect the manipulative skills which laparoscopic surgery required. The separation and privileging of technical skills over broader clinical expertise continue to reverberate today. In addition to its obvious benefits in ensuring high standards of manipulative skill, it has had the unintended effect within surgical education of displacing attention from other aspects of surgical practice, especially the holistic care of patients outside the operating theatre.

At the same time, a burgeoning patient safety movement was gathering momentum, and it became increasingly clear that clinical care in all specialties could inflict damage as well as conferring benefit. This contributed to the rise of simulation as a mainstay of education, arguing that many skills should be practised and perfected outside the operating theatre, where real patients would not be placed at risk of harm. Huge investment went into simulation facilities, with industries vying for position as suppliers of costly sophisticated simulators and related equipment. This focus on technical skills drew attention further away from the wider considerations of surgery as a holistic clinical practice (for its patients) and an educational community (for its practitioners).

At this point, assessment focused on details of technique, devising ways to measure what was measurable. Education became something to be measured, and assessment started to play a prominent role. Attention fixed upon what could be most easily captured and analysed. Metrics such as laparoscopic instrument path length, suture tension and time to completion of a procedure were used to assess progress and outcome. As outlined above, a growing sense of public unease and mistrust increased pressure to show that education was both formal and effective. One effect of a preoccupation with the technical aspects of keyhole surgery was to strive to show that training 'worked'. Here, the surgical community often framed its questions in a biomedical way, proposing and testing hypotheses and comparing groups of learners in the way that clinicians compare treatments or drugs. This quantitative approached dominated discourses of assessment and is still in evidence today.

The introduction of professional educators changed the way in which surgeons approached education. In the earlier part of the twentieth century, sociologists had observed surgeons but seldom worked directly with them as collaborators [11, 12]. Later on, educational expertise outside surgery began to make its way into the surgical world. The disciplinary traditions of education (rooted in the humanities and social sciences rather than the natural and physical sciences) brought a qualitative approach which in many ways was better suited to the questions which surgical education began to ask. A realisation grew that research into surgical practice and research into surgical education require different approaches.

As educationalists from outside medicine were brought in to provide specialist expertise, a tension between methodologies and philosophies of enquiry began to surface, with a growing sense that measuring what was easily measurable might not capture the complexities of clinical practice. Throughout these developments, there has been growing recognition that the educational side of surgical education resists 'simple' analysis of isolated skills and always plays out within a complex social context. Education in the current world shows a tendency for components of this whole to be hived off and separated. Many elements of current assessment are conducted outside the clinical setting and in assessment centres and simulation centres and performed by different kinds of expert. Although much has been gained – for example, in terms of demonstrating operative skill – other aspects (such as the expert but unquantifiable judgement of an experienced senior colleague) have been marginalised or devalued. Although formal curricula (such as the UK's Intercollegiate Surgical Curriculum Project) have articulated what is to be learned in terms of factual knowledge and technical skill, much remains implicit and eludes capture.

The unanticipated consequences of well-intentioned reform continue to defy prediction. For example, while mandatory reduction of duty hours has lessened the harmful impact of excessive working, the resulting fragmentation of clinical 'firms' has had serious repercussions on the development of surgical identity and a demoralising effect on social cohesion [13, 14]. Now surgical education is more nuanced, looking beyond isolated skills to seeing education as a process resulting in social and ontological change as well as the acquisition of knowledge and skill. There is great value in educationalists and clinicians working together, combining their perspectives and drawing on insights from other branches of medicine. In recent years,

collaborative working between educationalists and surgeons has led to a growing body of surgeon educators, developing a distinct professionalism of their own. This has included insights into the pedagogical practices of the operating theatre [15–17].

Returning to keyhole surgery, the distinctiveness of the new (at that time) way of performing surgery took attention away from the need to embed it in the same values of care as applied to any other kind of surgery. Yet a technicist focus sometimes eclipsed humanist values, giving undue prominence to the technical. This led to a disconnection from relevant insights within education (both medical and beyond) such as the groundbreaking work within general practice around the teaching of consultation skills and the role of simulated patients in the teaching and learning of complex clinical issues.

Keyhole surgery is an example of a process which in retrospect seems smooth and unruffled but which in fact took place by a series of leaps. The author has worked extensively with teams of pioneering surgeons from that time, using simulation to re-enact and document surgical and educational practices. These personal accounts give a vivid sense of the uncertainties and difficulties of introducing change within a professional setting. Building on those insights, the challenge now is to integrate surgical and educational expertise in order to remain responsive to an increasingly unstable world. Part of this instability is a consequence of relentless technical innovation. New approaches are being developed all the time, and what has become the new 'normal' in many surgical specialties will presumably be superseded by a new 'new'. Already interventional radiology, robotics, personalised medicine, genomic and phenomic science and diagnosis based on big data are challenging traditional framings of surgical practice and what it is to be a surgeon. Previously secure disciplinary boundaries are dissolving as former certainties unravel.

Surgical education must concern itself as much with who surgeons are and what they will become as with the techniques and skills they master and develop. Flux gives rise to opportunity and innovation but can also create uncertainty and discomfort. Alongside continual technical change is a widespread social instability and a worrying decline in morale. Within the profession, surgical identity is having to be refashioned. Events such as the Mid Staffordshire hospital scandal (where appalling instances of neglect and lack of care came to light within an NHS Trust) and the subsequent Francis Report [18] have highlighted failings of humanity and professional practice. Relationships between clinicians, patients, publics and society are continually being reconfigured, and surgical education must take all this into account.

2.1 Conclusions

As a clinician entering surgery, it is easy to think that things have always been as they are now. It is salutary to reflect on how much has changed over a single professional lifetime. The constantly accelerating rate of change means that challenges will arise at ever-decreasing intervals. Surgical education is shaped and defined as much by its social setting as by its professional and technical context. Perhaps, instead of following clinical innovation, surgical education should accompany or lead it.

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