pathways for neurobehavioural testing or management of patients with perioperative NCD.

Ultimately, adoption of the recommendations by Evered and colleagues[7] will depend on the greater community of investigators that study cognitive disorders after anaesthesia and surgery, and the policy of journals that publish their work. Other groups have attempted to standardize the diagnosis of POCD to allow comparisons of results between studies.[13] Despite the latter efforts, the criteria for detecting and defining POCD have remained variable and inconsistent over the ensuing quarter of a century since their opinions were published. Evered and colleagues[7] provide a thorough and thoughtful approach to address how to define cognitive changes after anaesthesia and surgery. Nonetheless, with the exception of delirium, neurocognitive decline after anaesthesia and surgery currently remains a research observation.

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Anaesthesia and the undergraduate medical curriculum

A. F. Smith[1,*], J. Sadler[2] and C. Carey[2]

[1]Department of Anaesthesia, Royal Lancaster Infirmary, Lancaster, UK and [2]Department of Anaesthesia, Royal Sussex County Hospital, Brighton, UK

*Corresponding author. E-mail: andrew.f.smith@mbht.nhs.uk

The title of this editorial is identical to that of an editorial published by Cooper and Hutton[1] in the *British Journal of Anaesthesia* more than 20 yr ago. At that time, the UK General Medical Council had, for the first time, published its document *Tomorrow's Doctors* to guide medical school curricula. The editorial's authors, academic anaesthetists from the University of Birmingham, set out their vision for how the specialty of anaesthesia could help deliver the knowledge, skills, and

attitudes required by all students, but also to those who selected additional modules of study. Much has changed in the intervening years. This Journal has become truly international. The General Medical Council has revised its guidance a number of times, and has just closed the consultation on its latest version of *Outcomes for Graduates*[2]; and a significant expansion of undergraduate medical education is planned for the UK. The specialty of anaesthesia has grown, and separate branches of critical care and pain management have flourished; and perioperative medicine has defined itself as a new focus for anaesthesia in many areas of the world.[3]

Times have changed in medical education too. Curricula are focusing less on acquisition of knowledge and instead on achieving competencies to equip students for work in complex clinical settings. Guided by learning objectives and outcomes, students' learning needs include not only facts, but also values, attitudes, and behaviour. Newer theories of learning emphasise its social aspects; one such approach, social cognitive theory, views learning as the consequence of an individual's interpretation of, and interaction with, their environment.[4] Learners become 'agents of experiences' rather than simply 'undergoers of experiences'. Teachers are no longer simply conduits of factual content but also 'enablers' of access to a community of learning.[5] Factual knowledge is of course essential as a basis for practice, but it is not in itself sufficient. Professional practice also requires the 'tacit', informal knowledge gained from observation of others, mindful rehearsal, and experience. Finally, knowledge is only complete when there is a moral and ethical dimension to complement cognitive understanding. To achieve all these facets of learning, there is no doubt that time spent in the clinical environment is essential.[6]

In the last 20 yr, there have also been a number of attempts to define what medical students should learn from us in anaesthesia and related specialties.[7,8] What is remarkably similar among these is the areas outlined where we can make a contribution. Cooper and Hutton[1] identified the following possibilities: (1) resuscitation, (2) practical procedures, (3) consent and ethics, (4) rapid history taking and preoperative assessment, (5) pre-admission assessment, (6) acute and chronic pain control, (7) recovery ward experience, (8) fluid balance and clinical pharmacology, and (9) intensive care and the consequences of technological medicine. In the course of preparing a new curriculum framework to guide undergraduate education in anaesthesia,[9] we derived eight domains of anaesthetic and critical care practice, setting out what we believed to be the key capabilities of doctors practising in anaesthesia and related specialties (Table 1). Some of these overlap with the list published 20 yr ago; others reflect the wider scope of our current work. Some of these subjects could be taught by any doctor, in any setting, and here anaesthetics and intensive care medicine can offer a useful complementary perspective. However, many areas of knowledge and skill are exemplified by anaesthesia and intensive care practice, and what is clear is that we can effectively foster the development of generic clinical skills in medical students.

One could argue that anaesthesia is a postgraduate specialty and we should therefore concentrate our educational resources on the postgraduate trainees who are destined to be the specialists of the future. We believe this view is misguided, and point, like Cooper and Hutton[1] and others since,[10] to the following reasons to involve medical students in anaesthesia and related specialties. First, as noted above, many of the skills and much of the knowledge needed by newly qualified doctors is our 'stock in trade'. We thus have a pivotal role (if we choose to play it) in ensuring that new medical graduates are well prepared for practice. Second, it promotes the specialty within medical schools. Third, it also helps recruitment into our specialty. Our style of practice, the opportunity to link basic science and clinical work, and the potential for combining practical skills and high-level concepts appeal to many students, but this cannot happen without exposure to anaesthetic work. This benefit has been noted not only in the developed world,[11] but also in less well-resourced nations where many people lack access to basic anaesthesia care.[12] Finally, even doctors who do not plan to take up a career in anaesthesia (and this will be the majority of graduates) will gain an understanding of the relevance of anaesthesia, critical care, and pain management to their work.

Nevertheless, anaesthetists' involvement in the undergraduate curriculum is variable. A Canadian study investigated the contributions made by the specialty to pre-clinical medical education and found that, although it had increased in the previous 15 years, this was not in proportion to the growth in anaesthesia faculty.[13] This prompted the writer of an accompanying editorial to ask whether we are missing an opportunity by not getting involved in pre-clinical medical education.[14] In this respect, Tien and colleagues[11] reported a week-long elective module in anaesthesia for pre-clinical (first- and second-year) students, comprising teaching, shadowing, and procedural workshops. Although the numbers of student evaluations were small, the report demonstrates that it is never too early to expose students to the practical side of our work. Anaesthetists can provide a unique and practical clinical perspective on cardiovascular and gastrointestinal physiology, to name but two systems, and their knowledge of

Table 1 The key capabilities of doctors in anaesthesia and related specialties

Manipulation of consciousness (sedation, anaesthesia, and psychological techniques, e.g. anxiety management)
Airway management
Circulation management
Pain management
Preoperative assessment: understanding and communication of risk and safety, and discussion and decision-making relating to the appropriateness of interventions
Operating theatre/perioperative management and leadership
Specific and generic procedural skills
Discussions around end-of-life care
Recognition and care of the deteriorating patient

how drugs work in practice can complement theory-based instruction in pharmacology.

Later in the undergraduate course, workplace teaching has much to offer students. Practical skills—not only airway management and cannulation[15,16] but also possibly ultrasound[17,18]—can be taught. One study that investigated the 'delivered', as opposed to the 'specified', curriculum in a New Zealand medical school found that there was sometimes a mismatch between students' expectations of learning skills and the reality of the placement.[19] Our style of practice also lends itself to students learning about teamwork, communication,[20] and other elements of practice that contribute to patient safety. Finally, 'preparing for practice' is a recognised element of the later years at many medical schools, and we could easily take the lead on these activities.

Critical care has much to offer students. Its 'horizontal' structure allows simultaneous exposure to numerous subspecialties of medicine; it encourages vertical integration between theoretical material and ward experience; and it gives access to procedural and patient management aspects of the acutely ill which are not often encountered elsewhere. However, critical care attachments must be carefully handled. A recent study from Ireland explored students' perceptions of the ICU as a learning environment.[4] There were a number of challenges to learners which were not found on general hospital wards. Nevertheless, an attachment to a critical care unit offers students the opportunity to see how, and why, some patients are admitted to the ICU and learn why some patients do not benefit from admission. It also allows a different perspective on end-of-life care in patients whose lives cannot be saved. A recent article from the UK outlined practical suggestions for how a critical care attachment might be organised.[21]

In terms of pain management, a recent European survey concluded that pain teaching in many European medical schools fell short of what might be expected given the prominence and public health burden of pain.[22] In addition, there is continuing evidence that pain is still not optimally managed in hospital.[23] Enhancing undergraduate education in this clinical field can only be beneficial. A simple short course in pain management ('Essential Pain Management') has been promoted for use in medical schools, with some success in the UK. It uses a 'recognise, assess, treat' model for pain applied to instructive case studies. In the perioperative context, a 'reverse pain ladder' is useful, starting with local anaesthetics and strong opioids immediately after surgery, and 'stepping down' to less potent agents as the pain becomes less severe.[24]

Perioperative medicine is a logical extension of anaesthesia and critical care,[3] dealing with the assessment and optimisation of the patient's condition before surgery, and providing enhanced rehabilitation after operation. Correcting chronic health conditions, such as anaemia, and optimising diseases such as chronic obstructive pulmonary disease, tends to improve postoperative outcomes. There is the potential for longer-term public health benefit to the perioperative encounter, over and above the better surgical outcome. For instance, diagnosing and treating arterial hypertension before surgery should stand such patients in better stead for the rest of their lives.[25] In educational terms, there are few better illustrations of the complex interaction of social, physiological, and surgical needs than emergency laparotomy and fractured neck of femur; this is exactly what newly-qualified doctors will have to deal with from their first day on the hospital wards. Thinking more broadly, these procedures are exemplar conditions where, contrary to the way care is currently organised, the health needs of patients might be better met on medical rather than surgical wards. Anaesthetists are in a prime position to bridge this divide. One of the authors (A.F.S.) has used one of the weeks of the fourth-year undergraduate surgical rotation to develop a 'perioperative' week. Students join the post-admission ward round in the morning of the first day and can then follow a patient to the operating theatre in the urgent general surgical list in the afternoon. Time in both nurse-led and anaesthetist-led preoperative assessment clinics is built into the week, as are elective operating lists and time in the ICU and recovery room.

Published in 2017, the UK Royal College of Anaesthetists has sponsored the development of a national curriculum framework for undergraduate education in anaesthesia. We followed an inclusive process of curriculum design, aiming to promote high-level learning amongst students, fully described elsewhere.[9] We conducted telephone interviews with anaesthetic educators at 33 UK medical schools identified from a list held by the Royal College of Anaesthetists. The question prompts were piloted and refined before being used in the interviews proper by one of two members of the project team. The respondents were largely senior (consultant level or senior lecturer) employed directly by the universities concerned (often as year leads or heads of programmes), or within the local NHS but with a university connection. The survey data were summarised using the usual standard descriptive methods and standard qualitative analytical techniques, by the same individuals, with methodological and thematic contributions from the other members of the team as required.[9] We later held a consultative national workshop to feed these findings back, identify barriers to anaesthetists' involvement with undergraduate education, and set broad aims for the final framework. We also created a brief suggested syllabus for content. The final document is available online[26] and a compendium of existing resources and examples of current activities in a selection of medical schools has been published separately.[27]

What of the future? We would encourage colleagues to become more involved with undergraduate medical education, if they are not already, for the reasons outlined above. We are aware that there are some obstacles to this; our workshop participants mentioned lack of time, poor linkage between funding and educational activity, and the risk of 'saturation' of good teachers as difficulties.[9] They also perceived problems with 'ownership' of course content (possible overlap with surgery, acute medicine, and emergency medicine), lack of involvement with assessment of students, and possible issues with patient consent. Some of the examples in the above mentioned compendium[27] illustrate how anaesthesia departments have dealt with some of these challenges. Anaesthesia and related specialties are in a unique position to educate and influence the next generation of doctors. There are, too, many educational opportunities and techniques which are currently not fully exploited; simulation for one, and also the possibility of longitudinal attachments based around the perioperative encounter, stretching from the first consideration of referral for surgery in primary care right through to follow up, say 3 or 6 months after operation. Who knows, too, what educational consequences may follow from service re-organisation? If the anaesthetists of the future are the ones to provide the majority of preoperative, postoperative, and intraoperative patient care (with the surgeon's main role becoming that of operative technician), the educational potential of this model is tremendous.

Many anaesthetists, pain management, and intensive care physicians throughout the world are successfully engaged with training students in practical procedures. But part of the role of a medical educator must be to link practical skills to patient care as a whole. Clearly, then, setting out learning objectives for factual knowledge is important, but a carefully structured session in the operating theatre, the preoperative assessment clinic, or the ICU, can help students understand the totality of professional work in anaesthesia and intensive care. The curriculum framework we have produced aims to 'modernise' the teaching of anaesthesia and related specialties. We hope that it will help anaesthetists show how we can contribute to the development of thoughtful, skilled, compassionate doctors of the future.

Authors' contributions

Wrote and revised the first draft of the editorial: A.F.S.
Addition of material and critical comments: J.S., C.C.

Declaration of interest

No financial interests declared. All authors were involved in the production of the Royal College of Anaesthetists' undergraduate curriculum framework described in the editorial. C.C. is a member of Council of the Royal College of Anaesthetists.

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