Undergraduate education in anaesthesia and related specialties: a compendium of current practice and resources for educators

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Abstract

We have previously reported the development of the first UK national framework to guide undergraduate education in anaesthesia, perioperative medicine, critical care and pain medicine. This followed an inclusive process of curriculum design aiming to promote high-level learning amongst students. We conducted telephone interviews with senior anaesthetic educators at 33 UK medical schools to establish current provision and practice, then held a consultative national workshop to set broad aims for the final framework and gather information. This paper contains examples of current educational practice selected from ten UK medical schools, presented according to eight key domains of anaesthesia and critical care practice. We have also collected undergraduate educators’ practical suggestions for enhancing the learning environment and student experience. The paper aims to provide support and guidance for medical schools in the development of competent, well-rounded doctors who are able to provide safe, patient-centred care in all areas of medical practice.

Keywords: anaesthesia, intensive care, peri-operative medicine, undergraduate, curriculum

Introduction

The specialty of anaesthesia encompasses operating theatre work, intensive care, perioperative medicine and pain management. Anaesthetists’ key capabilities can be summarised as: manipulation of consciousness; airway and circulation management; pain management; understanding and communication of risk and patient safety; recognition and care of the deteriorating patient; discussions about end of life care; and procedural skills. The anaesthetist’s
expertise covers many areas that are unique to anaesthesia, but anaesthetists and intensive care physicians can also offer a useful complementary perspective in other areas of clinical practice and basic science.

Within the UK, it was not clear to what extent anaesthesia and related specialties featured in undergraduate curricula. The Royal College of Anaesthetists has never provided formal guidance for undergraduate education in anaesthesia in the United Kingdom. With the support of the College, we used an inclusive and participatory process to develop guidance to assist undergraduate educators and the medical schools they work in to promote learning amongst medical students attached to the community of anaesthesia and related specialties.

As part of the development of the resulting curriculum framework, we compiled examples of current activity in undergraduate education in the specialty, together with practical suggestions from educators.

**Methods**

The development of the curriculum framework was initially proposed to support developmental work in education and training arising from the Royal College of Anaesthetists’ Perioperative Medicine Programme, which was launched in 2015. However, it soon became clear that adopting a broader remit to encompass anaesthesia, intensive care, pain management and perioperative medicine would be a more useful approach. The methods we followed are reported in detail elsewhere (Smith et al, submitted). In brief, we undertook a telephone survey of anaesthetic teachers representing medical schools in the United Kingdom in order to establish a baseline for current educational practice (Frith et al 2017). We later hosted a day-long consultation workshop for undergraduate anaesthetic educators at the Royal College of Anaesthetists. This aimed: to gather further advice on structuring the proposed national undergraduate framework; to collect and share examples of current educational activity; and to help establish a national network of those interested and active in undergraduate education in anaesthesia and related specialties. The authors formulated eight key domains of practice in anaesthesia and intensive care medicine (Table 1), and then worked through the General Medical Council’s *Outcomes for Graduates* (General Medical Council 2015) mapping the learning outcomes in the document to the eight domains referred to above. The final version of the curriculum framework was launched in November 2017 at a follow-up event for undergraduate trainers and is available on the Royal College of Anaesthetists’ website (Sadler et al. 2017). Here we outline those domains, giving illustrative examples of current practice across several UK Medical Schools, to act as a resource for undergraduate educators.

**Table 1**

**Domains of practice in anaesthesia and intensive care medicine**

1. Recognition and management of the acutely ill patient.
2. Applying basic sciences to clinical practice.
3. Supporting decision-making for optimal patient care, including end-of-life care.
4. Problem solving in clinical care.
5. Communication, collaboration and negotiation.
6. Practical pharmacology.

7. Safe and effective practical procedures.

8. Understanding fallibility, managing risk.

**Results**

**Domains of anaesthetic practice with illustrative case studies**

*Domain 1: Recognition and management of the acutely ill patient*

- Assess and recognise the severity of a clinical presentation and a need for immediate emergency care.
- Diagnose and manage acute medical emergencies.

**Case study – Newcastle**

Students at the Wear Base Unit of Newcastle University Medical School take advantage of several learning opportunities available to them in intensive care. Medical students have several placements throughout their final years. In their first visit they discuss the work of an ICU, how and why patients are referred for expert critical care assessment and intervention, and what can and cannot be accomplished by an admission. The intensive care doctors run a simulation workshop on ‘the deteriorating patient’. Their next visit is part of a larger module on infection control. During this block they shadow an intensive care nurse to learn why infection control is important, as well as what should be done every day to prevent it. Numerous students have chosen to participate in optional modules in intensive care medicine and the inter-professional nature of the specialty. The importance of the management of acutely ill patients is emphasised by assessment of this topic in the students' final exams. Teaching of acute medicine in a safe and familiar learning environment

**Case study – Dundee**

Dundee Medical School teaches the recognition and management of the acutely ill patient from many different perspectives. Inventively, by utilising different contexts, including the emergency department, operating theatres, the intensive care department and even GP practices and prehospital paramedic assessments, they allow insight into how different specialties manage their acutely ill patients. In addition, they use a formative OSCE assessment in ‘high fidelity’ simulation to drive learning. Each student receives individual comments on their assessment, with a video of their ‘performance’ to take away and review in their own time. To reinforce learning out of the hospital, the medical school has developed an Acute Care Guide app. This contains local and national protocols for managing various acute emergencies and many other documents used by both junior doctors and medical students.

*Domain 2: Applying basic sciences to clinical practice*
■ Explain normal human structure and functions.

■ Make accurate observations of clinical phenomena and appropriate critical analysis of clinical data.

Case study – Warwick

During the first year of the undergraduate course at Warwick, anaesthetists are at the forefront of the delivery of basic science teaching. The sciences are taught both formally and in an ‘ad-hoc’ way by clinicians in tutorials and in the hospital setting. Later during the year, clinical anaesthetists select specific patients to further examine and explore how their physiology affects their clinical picture, and why pharmacological interventions are used. This allows students to apply their prior scientific understanding to real life situations. In the following years tutorials and simulator sessions are used to explore how to treat common and basic clinical problems such as acid-base disturbances, electrolyte abnormalities, oxygen desaturation, hypertension, hypotension and cardiac arrhythmias.

*Domain 3: Supporting decision-making for optimal patient care, including end-of-life care*

■ Formulate a plan for treatment, management and discharge, according to established principles and best evidence, in partnership with the patient, their carers, and other health professionals as appropriate. Respond to patients’ concerns and preferences, obtain informed consent, and respect the rights of patients to reach decisions with their doctor about their treatment and care and to refuse or limit treatment.

Case study – Lancaster

Lancaster Medical School has driven the integration of medicine, surgery and acute care to enable a patient-orientated approach to care. Students see the full patient perioperative pathway from referral to rehabilitation. For example, the students spend a session with preoperative assessment nurses seeing straightforward patients, and a session in the anaesthetist-led assessment clinic to see more complex issues. The focus during both encounters is on formulating a plan, together with patients and their carers, for anaesthetic technique and perioperative care, tailored to the patient’s wishes, needs and co-morbidities.

*Domain 4: Problem solving in clinical care*

■ Make clinical judgements and decisions, based on the available evidence, in conjunction with colleagues and as appropriate for the graduate's level of training and experience. This may include situations of uncertainty.

Case study – Brighton

Brighton Medical School lays the foundations for doctors to act as problem solvers early in their students’ clinical experience. During a scenario-based course, students are expected to demonstrate how they would treat a variety of
common clinical situations in perioperative and intensive care settings. They are taught both the physiological and pharmacological reasons for treatments and how to recognise, and seek help with, sick patients. Each student is given the opportunity to explain how, and justify why, they acted and thus explore the complexity and variety of methods for clinical problem solving. Teaching students to justify decision making

**Domain 5: Communication, collaboration and negotiation**

- Communicate effectively in various roles, for example, as patient advocate, teacher, manager or improvement leader.

- Contribute to the care of patients and their families at the end of life, including management of symptoms, practical issues of law and certification, and effective communication and team working.

**Case study – Plymouth**

Plymouth has a novel approach to teaching airway management that demonstrates the importance of teamwork and collaboration. Following on from pre-reading, e-learning, face-to-face teaching from an anaesthetic consultant and a session at the ENT clinic, students are brought into ENT theatre. Here, students see the full spectrum of airway problems from the anaesthetic and the surgical perspective, are taught and invited to practice maintaining the patient’s airway, discuss how best to manage the airway during the surgery, and then scrub for the operation. This puts theory into practice, and more importantly, highlights the different views of the surgeon and anaesthetist and how these marry together to ensure the best possible patient outcome.

**Domain 6: Practical pharmacology**

- Calculate appropriate drug doses and record the outcome accurately.

**Case study – Edinburgh**

One of the major benefits of medical students being engaged in perioperative medicine is for them to see the direct effect of pharmacological manipulation on physiology. This is a major focus of students’ placements in theatres and intensive care in the Edinburgh course. This gives students a chance to become truly involved by being allowed draw up drugs and prepare infusions under close supervision. Clinicians within the work environment also engage students by questioning before, during and after specific drugs are given, exploring the proposed benefits, risks and outcomes. Where results are not as expected, the student is encouraged to research why. This heightens the awareness of the complexity of pharmacology in the critically ill. Practical understanding of drug management

**Case study – Bristol**
Bristol is one of many medical schools to have incorporated the Essential Pain Management (EPM) course into their curriculum, to allow their students to benefit from a standardised method of teaching both acute and chronic pain management. The half-day course consists of brief lectures to consolidate and systematise existing knowledge, with case discussions to apply the knowledge to a range of clinical scenarios. Bristol has chosen to minimise the didactic element and focus on small group discussions around clinical cases, as this had previously received excellent feedback. They chose to adapt the patient scenarios to reflect the experience of those attending the course. The course materials are freely available on the Faculty of Pain Medicine's website (www.fpm.ac.uk) and include both student and instructor manuals, slide sets and evaluation forms.

**Domain 7: Safe and effective practical procedures.**

Case study – Belfast

Belfast epitomises modern teaching of effective practical procedures by having a graduated exposure to clinical skills. Students start in the skills laboratory with the clinical skills team, learning the best practice of skills on manikins. Their first opportunity to use their newly acquired skills in vivo is under direct consultant supervision in the anaesthetic room, where the finer points of practice can be understood. Finally, students are supervised by a cohort of junior anaesthetic doctors to allow them to master their skills without compromising the patient experience. Utilising junior anaesthetic doctors is a major benefit to the students' training, as they are closer in age and experience to the students. It also allows the doctors to develop their own teaching skills.

**Domain 8: Understanding fallibility, managing risk**

- Place patients’ needs and safety at the centre of the care process.
- Manage time and prioritise tasks, and work autonomously when necessary and appropriate.
- Deal effectively with uncertainty and change.

Case study – University College London (UCL)

The medical school at UCL uses the World Health Organization (WHO) surgical safety checklist as the cornerstone of its ‘Safety, Risk and Recovery’ tutorial. The students are given the background to why errors are made and taught human factors in an online format. The face-to-face tutorial with an anaesthetist revolves around a wrong-site surgery scenario, exploring the role of the WHO surgical checklist in preventing harm, and how students might behave if faced with the situation. In their Procedures booklet, they must watch the WHO checklist in action and are then supported in leading ‘the WHO’ for a patient's journey, from anaesthetic room to recovery. Reflecting on this real-life experience, which builds on their knowledge from their online learning, students have a deeper understanding of the factors that contribute to patient harm. They also recognise the role of cognitive aids, such as the WHO checklist, in sharing safety-critical knowledge amongst teams and helping healthcare professionals to speak up when patient safety may be threatened.
Suggestions for educational programmes

The following areas represent examples of current practice which may help in the development or effective delivery of an educational programme

Course content: Teaching basic sciences, perioperative medicine and non-technical skills.

- Basic sciences can be brought to life in the clinical setting, for instance by using ultrasound to demonstrate practical anatomy, and cardio-pulmonary exercise testing to explain exercise physiology, ‘prehabilitation’ and risk stratification.

- More unusual topics such as global surgery and anaesthesia, disaster medicine, expedition medicine and diving medicine, can illustrate basic physiological and clinical management principles.

- Tutorials on guidelines and pathways can be invaluable in exploring patient management options, rehearsing the necessary actions and explaining how to get help with sick patients; for example, working through a ‘major haemorrhage’ protocol can both highlight basic science and give students confidence in managing this situation in the future.

- Using perioperative risk calculators (for instance, www.sortsurgery.com or http://riskcalculator.facs.org) can promote the wider use of these valuable perioperative tools and open up discussion about shared decision-making with patients, active preparation for theatre and promoting recovery following surgery.

- Teaching on topics such as handovers of care can be incorporated into almost any clinical setting; incorporating such issues into students’ assessments underlines the importance of these ‘non-technical’ aspects of care.

Methods of delivery: Online, in tutorials and in and around the hospital.

- Online materials offer great potential. For instance, it is possible to post a curriculum outline with a learning booklet including practical procedures. ‘Flipped learning’: regular emails with linked podcast/article. e-Learning is also useful as it is easy to access; many educational materials can be posted including podcasts, ‘learning cases’ and examples of assessment questions. This can be updated every year as the curriculum changes.

- Electronic lectures and modules may be created by the course providers, or chosen from the well-recognised e-Learning for Health and e-Learning Anaesthesia. These resources provide up-to-date materials and allow the student to learn at their own pace, as well as self-asses and explore other related content.

- Students can benefit from the use of case-based scenarios to stimulate discussion of basic sciences. It is also possible to invite senior students or junior anaesthetists to teach, though this might need careful facilitation to make sure all benefit from the experience.

- During hospital attachments students can shadow enthusiastic trainees and consultants; join in on-call shifts in emergency operating theatres; and carry bleeps and be bleeped to simulations of situations they will encounter as Foundation doctors (e.g. a ‘collapsed’ patient, or completion of a discharge prescription).
Prepare ‘packs’ of learning materials to keep in the operating theatre (e.g. arterial blood gases, ECGs, discussion cases) to refer to or for students to read.

Teaching can be a challenge when time is short and service pressures keenly felt. However, there is published advice on teaching in such conditions and it must also be borne in mind that formal teaching does not need to take place for students to learn; role modelling and observation are powerful tools, especially when one considers the importance of unarticulated knowledge and clinicians’ personality and behaviour in their work.

Students can benefit from attendance in a variety of out-of-theatre perioperative settings including preoperative assessment clinics (both nurse and medically led), CPET testing sessions, acute pain rounds and multidisciplinary meetings.

Organisational: Courses, hospital arrangements and allowing students to go beyond the curriculum.

Advanced life support-type courses can be designed and set up for students.

Multidisciplinary ‘Trauma weekends’ where students are exposed to the theory and practice of major trauma management have also been tried.

Identifying a ‘named consultant’ for undergraduate education can be helpful – this is then the person to whom problems and queries can be directed and acts as a central consistent point of contact.

Experienced nurses should take part in medical education; for instance, specialist pain nurses can undertake pain teaching and resuscitation training staff can teach acute care topics and skills.

Emergency medicine, intensive care and ENT can be integrated for a broader perspective on teaching about airway problems and management.

Education and Simulation Fellow posts can be created which both allow trainees to develop their educational portfolio in a structured manner and at the same time provide useful teaching within clinical departments.

It is very helpful to have clear arrangements linking the undergraduate funding coming into a department with the provision of time within teachers’ job plans and the expectations for delivery of teaching.

Anaesthetists and intensive care physicians can promote their specialties and complement teaching within the curriculum by encouraging and supporting a perioperative medicine/anaesthesia/intensive care medicine society and by contributing to medical school careers events.

Gathering and distributing timely feedback to teachers about their educational activities allows teaching quality to be maintained and improved but also provides supporting material for doctors’ educational appraisals.

Within departments of anaesthesia, intensive care and pain medicine, some teachers are more enthusiastic than others. If possible, they can be ‘rotated’ in and out of teaching to avoid overburdening the more enthusiastic ones and avoiding ‘fatigue’.

Many schools have established Student Selected Modules and intercalated degrees in anaesthesia, perioperative medicine and related specialties with considerable popularity and success for the organising departments and the
students themselves. These options allow students to further explore anaesthetics, participate in research, or enter academia through presentations, attending conferences and making academic posters. These courses act to establish anaesthetics as both a clinical and academic subject.

**Discussion**

The development of the main curriculum framework and its educational implications are considered elsewhere (Smith et al, submitted). In this paper we aimed to document and share some useful current educational activities and resources within a specialty-specific framework linked to the General Medical Council's *Outcomes for Graduates*. These were collected during the process of framework development from undergraduate educators in anaesthesia throughout the United Kingdom.

There have been relatively few recent attempts to set out what medical students should learn about anaesthesia, and how this might be achieved. However, some literature exists for critical care (Conte et al 2016; Khan et al 2017; O'Connor E et al 2017) and pain management (O'Connor M 2017; Briggs et al. 2015). Other work has made suggestions for the teaching within ‘pure’ anaesthesia (Sidhu 2015). We hope that the material presented here will help undergraduate educators in anaesthesia and related specialties.

**Take Home Messages**

A national UK curriculum framework for medical student education in anaesthesia, intensive care, pain management and perioperative medicine has recently been published.

This paper presents illustrative case studies of educational activities drawn from ten UK medical schools to support the framework.

Practical tips and suggestions from undergraduate educators in these specialties are also reported here.

**Notes On Contributors**

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Bibliography/References

Frith C, Stephens R. Undergraduate teaching in anaesthesia, critical care, pain and perioperative medicine. Royal College Anaesthetists’ Bulletin 2017; 106: 36-8

General Medical Council. Outcomes for Graduates. 2015; Retrieved from https://www.gmc-uk.org/Outcomes_for_graduates_Jul_15_1216.pdf_61408029.pdf

Khan N, Jovestani K, Spencer C, Man R, Pugh M, Woywodt A. Twelve tips on how to establish a new undergraduate firm on a critical care unit, Medical Teacher 2017; 39:3, 244-249

https://doi.org/10.1080/0142159X.2017.1266314

O’Connor E, Moore M, Cullen W, Cantillon P. A qualitative study of undergraduate clerkships in the intensive care unit: It's a brand new world. Perspectives Medical Education 2017; 6(3):173-181.

https://doi.org/10.1007/s40037-017-0349-x

O’Connor M. EPM Lite. Teaching Essential Pain Management to medical undergraduates – and beyond. Royal College of Anaesthetists’ Bulletin 2017; 101: 18.

Rohan D, Ahern S, Walsh K. Defining an anaesthetic curriculum for medical undergraduates. A Delphi study. Medical Teacher 2009; 31

https://doi.org/10.1080/01421590802334291

Sadler J, Carey C, Smith A, Smith H, Stephens R, Frith C. Science, skills and safety: a framework for medical student education in anaesthesia, intensive care, pain and perioperative medicine 2017; Retrieved from https://www.rcoa.ac.uk/system/files/ComptencyFramework2017.pdf

Sidhu N, Weller J, Mitchell S. Teaching and learning in undergraduate anaesthesia: a quantitative and qualitative analysis of practice at the University of Auckland. Anaesthesia & Intensive Care 2015; 43, 740-749
Appendices

Declaration of Interest

The author has declared that there are no conflicts of interest.