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Teaching evidence-based medicine to undergraduate medical students: a course integrating ethics, audit, management and clinical epidemiology

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ABSTRACT *A six-week full time course for third-year undergraduate medical students at Imperial College uniquely links evidence-based medicine (EBM) with ethics and the management of change in health services. It is mounted jointly by the Medical and Business Schools and features an experiential approach. Small teams of students use a problem-based strategy to address practical issues identified from a range of clinical placements in primary and secondary care settings. The majority of these junior clinical students achieve important objectives for learning about teamwork, critical appraisal, applied ethics and health care organisations. Their work often influences the care received by patients in the host clinical units. We discuss the strengths of the course in relation to other accounts of programmes in EBM. We give examples of recurring experiences from successive cohorts and discuss assessment issues and how our multi-phasic evaluation informs evolution of the course and the potential for future developments.*

Practice points

- Undergraduates can learn the principles of evidence-based medicine (EBM).
- Existing courses focus more on finding evidence and on critical appraisal skills.
- This course describes a successful experiential holistic approach to EBM teaching integrated with ethics and the management of change.
- Junior clinical students can prompt significant changes that make clinical care more evidence-based.
- Widening participation in the course to allow multi-disciplinary teamwork would usefully reflect the reality of working in a modern health care system.

Introduction

All undergraduate medical students at Imperial College London undertake an integral BSc degree during their six year course. This begins with a six-week 'Foundation Course' in year 3, soon after students have started their clinical work, providing basic skills for a full 'Science Year' in year 4. As recommended by the General Medical Council (GMC), students are given a wide choice of courses (GMC, 1993 revised 1997, 2003). Such courses offer opportunities for innovation.

From 2003–2004, we combined separate courses on EBM and on ethics, taken by 150 students over four years and progressively refined, into one six week course 'The ethics and practice of introducing evidence-based medicine (EBM) in to patient care'. This leads into a BSc in Social Medicine or in Health Management. We address wider aspects of medical practice including managing change, working in teams, audit and application of ethical principles. We introduce students directly to the application (or not) of evidence in real clinical settings and the realities of organisational and contextual barriers (Rogers, 1995; Ferlie, 1997; Wood *et al.*, 1998; Fitzgerald *et al.*, 1999).

The course

The course is built around a variety of clinical placements (Box 1). Teams of six students are assisted by a 'placement tutor' from the host clinical unit. Each team works through an entire audit cycle, from identifying an issue to making recommendations for change (Figure 1). This fieldwork cycle is complemented by carefully-sequenced classroom sessions where key concepts, ethical issues and important skills (including searching the literature) for the fieldwork task are identified, discussed and practised. The Tanaka Business School makes a key contribution, including change management techniques (Ferlie *et al.*, 2000; Paton & McCalman, 2000) and how different personality types affect teams (Hirsh, 1985; Belbin, 1993; Belbin, 2003).

A pair of 'seminar leaders' gives continuity to each set of three placement teams (eighteen students). The comprehensive workbook, including key readings, draws on a published text (Greenhalgh & Donald, 2000). Ethical issues, such as pharmaceutical industry sponsorship and prescribing practice, are tackled via reflection, discussion and debate.

A plenary presentation of audit projects ends the course. Each team explains the relevance of their audit topic, their identified good practice standard, what they did, what they found and their recommended changes. Placement hosts welcome these last. Placement sites are selected for their commitment to evidence-based health care (EBHC), and are systematically given formative feedback during each project.

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Box 1. Examples of recent placements.

Hospital unit	Diagnostic service	Primary care
Surgical unit	Microbiology laboratory	General practice
Neonatal unit	Histopathology laboratory	Community psychiatric unit
Labour ward		Care of the elderly day unit
Intensive care unit		Hospice

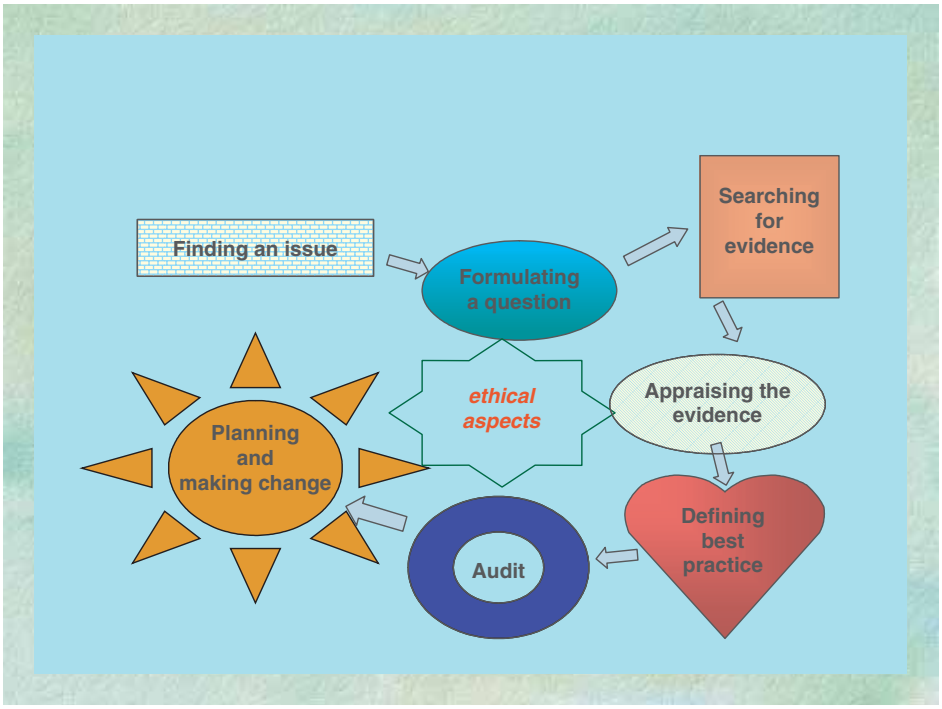

Figure 1. Scope of the course in evidence-based health care.

Aims

We aim to help students:

- Understand the scope of EBHC.
- Appreciate the challenges of changing organisational systems and health professionals' behaviour.
- Explore relevant ethical issues.

Objectives

The student learning objectives reflect both content and delivery of the course, including:

- Appraisal of different types of evidence.
- Practical understanding of ethical principles in relation to their projects.
- Participation in a clinical audit.
- Management of change and organisational development.
- Awareness of their own strengths, weaknesses and likely contribution to teamwork.
- Professional values and behaviours.

Assessment

In-course assessment, comprising 50% of final marks, consists of:

- Critical appraisal of a published paper relevant to the student's placement.
- A written account of the whole project.
- Evaluation of the individual's performance as a member of the placement group.
- A shared mark with the rest of the team for the final oral presentation.

Coursework marks are blueprinted against a grid of the course objectives.

The two-hour written examination includes a compulsory question (usually critical appraisal of a research paper distributed beforehand), and two further questions chosen from four alternatives.

Evaluation

The course itself is reviewed from the perspective of students and staff using Kirkpatrick's four levels of evaluation as adapted by Barr *et al.* (2000) (Box 2). In 2004, evaluation included:

- One-to-one student–tutor discussions at formative mid-course appraisals.
- Direct observations (seminar leaders, lecturers, placement tutors and course administrator).
- Diary records and running notes (course co-ordinator).
- End-of-course questionnaire (participants).
- Review of coursework, group presentations and examination scripts (teaching staff).

Box 2. Kirkpatrick's four levels of evaluation, adapted for medical education.

Level	Description	Example of method of evaluation
1	Learners' reactions	Questionnaires and interviews with students
2a	Modification of attitudes and perceptions	Focus groups with students Placement and seminar leaders' reflective diaries
2b	Acquisition of knowledge and skills	Examination of the content of the coursework, group presentations and examination scripts
3	Change in behaviour	Reports from placement sites of changed practice
4a	Change in organisational systems	Reports of change from placement sites
4b	Benefits to patients or clients	Beyond the scope of this programme

Box 3. Changes flowing from evaluation of the programme for 2003–2004.

The introductory session will stress:
- although much of the course will be new and unfamiliar, it is all mandated by *Good medical practice* and students will be helped through the process;
- the course is not about Social Medicine or Management *per se*, but gives students core knowledge and skills required for the Science Year.

The talk introducing audit will be delivered sooner, as audit forms the central focus of the fieldwork and written report.

Instructions will indicate that written reports should include:
- what was learnt;
- what challenges were raised by the group process.

Consultants will be asked not to delegate aspects of placement tutorship to junior staff because these individuals have less freedom to change their rosters and clinical work gets in the way.

Box 4. Examples of projects undertaken by students on placement.

Use of a birthing pool in a labour ward.
Use of morphine in a hospice.
Handwashing in a neonatal unit.
Adherence to NICE guidelines in management of schizophrenia.
Drug monitoring in the elderly to reduce the risk of falls.
Prophylactic peri-operative antibiotics in abdominal surgery.
Use of peak flow meters in the management of asthma.
Prophylactic aspirin in the primary prevention of vascular disease in type 2 diabetes.
Optimal number of lymph nodes to be sampled in surgery for colorectal cancer.
Prophylaxis for systemic candidiasis in the seriously ill.
Use of clinical nurse practitioners to reduce the work of junior hospital doctors.
Use of statins in primary care.

- Nominal group technique assessment (one seminar group in week 4).
- External examiner's comments.

The multi-component strategy allows us to measure progress against the learning objectives, and improve the course (Box 3). Alternative evaluation frameworks for EBM (e.g., Straus *et al.*, 2004) are designed for practising clinicians rather than undergraduates.

Results

Fieldwork projects

Students have carried out a wide range of learning projects (Box 4). Some have also prompted significant improvements in everyday patient care. These successes span general practice (prophylactic aspirin in patients with diabetes), a neonatal unit (trophic feeding in the very premature) and histopathology (lymph node sampling for metastases in colorectal cancer). Such impacts motivate students to achieve their learning objectives and prompt positive feedback about the course. They also encourage the placement clinicians, who receive no NHS financial reimbursement (the BSc is classified as non-clinical).

Assessment

Most students succeed in reaching all their learning objectives. The external examiner confirms the very high average standard of the projects. Student feedback highlights facilitated team working, excellent course administration, the workbook and the enthusiasm of the placement tutors.

Evaluation

Despite its apparent overall success, some problems have recurred:

- Some students are tempted to address issues such as resource allocation, where EBHC is not appropriate or evidence is limited. Though a valuable learning point, this frustrates an evidence-based audit and choosing a new topic causes delay. We therefore advise placement tutors to emphasise areas with existing relevant published evidence.
- Some placement groups are dysfunctional, usually because of perceived inequality of individual contributions. We try to forestall this by including team-building exercises and the ethics of teamwork early on. Mid-course appraisal interviews with seminar leaders have helped expose these problems and encouraged affected groups to address them.
- Occasionally, staff at placement sites do not accept or respond to the evidence presented to them. This is frustrating (if also realistic) for students who require additional motivational support to complete the project.
- Punctuality and attendance at some seminars is poor, inhibiting placement team processes. This is a challenge for Seminar leaders promoting an adult learning ethos, where students take responsibility for their own learning.

Box 4 sets out changes following evaluation of the 2003–2004 programme.

Discussion

Medical students typically start their course enthusiastic, curious and eager to improve the human condition. They are soon immersed in a long curriculum, too often rather passively, where they have little direct involvement in the care of patients and thus no chance of 'making a difference'. This EHBC course is the exact opposite; students choose the problems to study and their findings often have immediate application to patient care, and make a palpable impact on clinical teams. This goes beyond students practising the application of theory in artificial circumstances, or even to choosing clinical problems on which to locate and appraise relevant articles (Jamrozik, 1996) to having them take responsibility for completion of the whole of a cycle of audit and change, with simultaneous consideration of ethical issues.

Ethical principles of medical practice are included in every undergraduate curriculum in the UK (Ashcroft *et al.*, 1998; Goldie, 2000) while many medical schools in the USA have a formal EBM course (Aiyer *et al.*, 2002). There are reports of EBM being taught at an undergraduate level in Germany, Malaysia, Israel and Sweden (R Wenz, personal communication, 2004), even in the preclinical years (Srinivason *et al.*, 2002), but few in the UK apart from Oxford (Rosenberg *et al.*, 1998). Some undergraduate EBM courses are linked to specialities such as family medicine (Wadland *et al.*, 1999), dermatology (Barnett *et al.*, 1999) and complementary medicine (Forjuoh *et al.*, 2003), but none to ethics and the management of change. The scope of such courses is narrow. Some turn clinical problems into questions, and most focus on published evidence and critical appraisal, although one report seems to equate EBM solely with critical appraisal skills (Norman & Shannon, 1998). An exception is an EBM course in Rochester, USA that teaches pre-clinical students a broader application including change management (but not ethics) (Holloway *et al.*, 2004). In contrast, our students learn about EBM and its application in real clinical settings; several have commented that the experience is so valuable that it should be part of the core curriculum rather than an elective unit.

Our course combines approaches that are educationally sound, having been shown previously to enhance learning, with concepts that are essential for the good practice of medicine (GMC, 2001). Working in small teams foreshadows much of the students' later professional lives, as does adoption of a problem-based approach where outcomes are not pre-defined. Because the groups' choices of topics and approaches vary widely, their tutors can only be facilitators and not omniscient experts. Students have to take responsibility for what they learn and when. Skills acquired are of career-long value. Rather than forming a compulsory aside, ethics assumes its rightful place as a central strand in medical work.

We are encouraged to find that junior students using EBM can affect the care received by patients. Other major strengths of the programme, much appreciated by students, are its experiential approach including real teamwork and critical support. These features are common to other successful EBM courses (Ghali *et al.*, 2000; Srinivason *et al.*, 2002). Elsewhere, problem-based learning has been enjoyed by students and staff and has a positive behavioural and social science learning outcomes. (Albanese, 2000; Dyke *et al.*, 2001; Farrow & Norman, 2003).

The future

Two nurses participated in our first EBM course with great success. This shows exciting potential for a fully multi-professional teamwork course, once formidable organisational barriers between different universities and disciplines are overcome.

But we have encountered a team-working paradox. Like modern health care, much of the success of the placement projects depends on teamwork, but Faculty policy is to assess students individually. It is impossible for staff to separate any individual contribution completely from the learning demonstrated by a whole project team. Moreover, group function (good or bad) modifies the assessed grade of each member. We think that much of the knowledge and skills acquired are poorly assessed by written examinations, and that in-course activities should carry even greater weight (currently 50%), particularly as assessment guides students' learning so strongly (Resnick & Resnick, 1992). As well as assigning groups a shared project mark, we have considered innovative summative assessments including an OSCE (Bradley & Humphris, 1999) and a purpose-designed questionnaire (Johnston *et al.*, 2003). Such changes are entirely consistent with our commitment to improving our course as new evidence comes to hand.

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KONRAD JAMROZIK initially trained in Adelaide and Hobart before completing a doctorate in clinical epidemiology in Oxford. After holding lectureships in public health in Universities in Papua New Guinea and Western Australia, he moved to London to take up a chair in Primary Care Epidemiology at Imperial College in December 2000.

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