The changing role of medicine in society and the growing expectations patients have of their doctors means that the content and delivery of medical curricula also have to change. The focus of health care has shifted from episodic care of individuals in hospitals to promotion of health in the community, and from paternalism and anecdotal care to negotiated management based on evidence of effectiveness and safety. Medical training is becoming more student centred, with an emphasis on active learning rather than on the passive acquisition of knowledge, and on the assessment of clinical competence rather than on the ability to retain and recall unrelated facts. Rigid educational programmes are giving way to more adaptable and flexible ones, in which student feedback and patient participation have increasingly important roles. The implementation of sustained innovation in medical education continues to present challenges, especially in terms of providing institutional and individual incentives. However, a continuously evolving, high quality medical education system is needed to assure the continued delivery of high quality medicine.

The burden we place on the medical student is far too heavy, and it takes some doing to keep from breaking his intellectual back.

Thomas Huxley, 1876

The WHO regional office for Europe has recently done a review of medical curricula in European countries1 and has identified ways in which changes in health care need to be addressed by changes in medical education. Although many of the details will differ outside Europe, the message is likely to be the same—that the changing role of medicine and our expectations of physicians have major implications for the design and delivery of undergraduate medical training. This article, the first in a series of four, examines these changes and looks ahead at the development of medical curricula.

Changes in medicine and society

However indebted new doctors are to individual teachers, few will leave medical school confident that their own medical course has prepared them completely for their chosen career. Whether or not it is inevitable that the curriculum lags behind this challenge, there is no doubt that the content of current courses is under pressure from numerous external forces. Shifts in disease patterns and personal goals are continually altering what society expects of its doctors. The delivery of health care has changed, and will change again. Fashions in education, funding constraints, and new regulations add further twists to the tale.

Currently, most developed societies, which our young doctors will serve, expect their adults to live on healthily into their 80s, and its children to grow up largely free of illness. That cancers should be cured and stresses identified and alleviated are no longer Utopian ideals. The Human Genome Project is likely to have massive consequences for medical care and doctor-patient relationships. Internet connections could make individual doctors uncomfortable about their own conditions. People make sophisticated lifestyle choices that assume an equally sophisticated form of health care. These and many other factors will affect the working lives of new doctors, and they therefore need to be incorporated into their professional preparation. Simply walking the wards might not be adequate, since many healing episodes do not happen there, and those that do could be difficult for students to understand, because treatments are complex and recovery usually takes place at home. General internal medicine and clinical methods can be taught and learnt in general practice,7 and the importance of educating students in ambulatory care settings has been recognised in North America, in response to the new demands of managed care.6

These changes have also altered the focus of health care (panel), which has shifted from the individual to the community, from cure of disease to preservation of health, from episodic care to continuous and comprehensive care, and from an individual approach, provided by single primary-care physicians, to comprehensive, community-based care, provided by primary-care teams. We are also witnessing a radical shift from paternalism to management negotiated in partnership between patients and physicians, which encourages concordance and patient enablement.7

There has also been a move from centralised systems to health services, which are primary care led, and from a reliance on inpatient care to the increasing use of home, day, and intermediate care. Anecdotal care is giving way to evidence-based medicine and, as part of the retreat from paternalism, the importance of revalidation, reaccreditation, and continuous professional development of all medical professionals has become a matter of public concern.1,2

These changes have significant implications for educational institutions. Learning has moved the concept of teaching from “know all” to “know how”, with an
emphasis on active learning rather than the passive acquisition of knowledge, and of problem solving rather than transmission of information without context. Integration of many disciplines in teaching and learning about health problems is now recognised as important, leading to more effective learning and a more rational use of educational resources. Rigid educational programmes have given way to more adaptable and flexible methods of curriculum delivery, and the acquisition of professional and clinical skills and attitudes now complements the mastery of technical knowledge. Curricula have shifted from being mostly teacher-oriented to much more student-centred, with student assessment having a significant role in curriculum review.

### Changes in focus of healthcare

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<td>The individual</td>
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<td>Cure of disease</td>
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<td>Individual approach, provided by single primary care physicians</td>
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In many European countries, traditional and integrated curricula are still being taught at the same time. In Sweden, the traditional curriculum at Umeå University consists of five preclinical, followed by six clinical semesters, with only minimal overlap. In Linköping University, by contrast, after a relatively brief theoretical start, students are introduced to concepts of health and disease and patient care early in the course. In Norway, the curriculum at Tromsø University is based on integrated, system-based learning, whereas the curricula at the universities of Bergen, Oslo, and Trondheim are more traditionally discipline based. Similar approaches to integration are being implemented in many other countries, notably Canada, Australia, and Ireland, and the UK. The result is increasing student choice, and perhaps competition between rival schools and curricula. Whether the public can depend on a sufficiently uniform product remains to be seen, and there is still uncertainty about the ability of integrated, problem-based curricula to deliver improvements in the knowledge base and in clinical ability.

In many countries, medical students are able to pursue studies leading to a higher degree as part of a flexible programme of training within the overall medical undergraduate curriculum. Bachelor of Science degrees can be intercalated at different stages and in basic science and clinical science topics. These seem to lead to a greater interest in research careers and to an improvement in study habits. Fast-track intercalated or integrated doctorates have also been introduced for gifted students in other schools; evaluations at Harvard, Pennsylvania, and Toronto suggest that these degrees are at least associated with development of research orientation and academic leadership.

### Changes in curriculum design

The prototype medical curriculum in Europe was a first degree course lasting 5–7 years in which basic sciences, taught in the early years, were sharply demarcated from clinical experience and learning, whereas a 4-year postgraduate course was the norm in USA. In the clinical years, hospital specialties dominated, and there was little scope for students to pursue individual interests. There was also often little regard for the needs and expectations of the health-care system in which the medical schools and universities were based. Although such an arrangement increased to a maximum the number of years a medical graduate offered in return for training, the demands on school leavers of such courses were high, and dropout, dissatisfaction, and student debt remain a dilemma in many countries.

One solution to this dilemma is to recruit mature students. The concept of medicine as a graduate course is most highly developed in USA, where medical undergraduates begin their studies after a first degree, which can be in a range of science and non-science subjects. In Australia, four schools have turned to graduate-entry programmes, at least partly because of the belief that graduate students are more likely to make a firm commitment to a medical course and will be more able to benefit from a programme of problem-based learning. In the UK and most other European countries, however, graduate or mature students remain the exception.

The idea of an integrated curriculum, in which clinical contact takes place in the early years and basic science teaching extends beyond the traditional first 2 years, is becoming established in various educational systems. In Germany, for example, experimental legislation has given several universities the opportunity to develop new methods of medical education and to test and assess them. Students have been centrally involved in many projects, including the medical reform curriculum in Berlin, and in Heidelberg students organise their own congress on medical education.
teaching delivered to students, and on the proportion of teaching done by departments of general practice, primary care, and public health medicine, and, correspondingly, on the site of teaching. There has been a move from dependence on inpatient settings to a mix of these with community-based placements.24 In Australia, similar changes have been encouraged by government funding initiatives aimed at increasing the medical workforce in rural and remote areas.25 At Flinders University, students can opt for a whole year in rural general practice and associated hospitals to complete all their required clinical rotations. The new medical school at James Cook University, Townsville, has a brief to develop rural and community-based programmes in the north of Australia. Public-health medicine now comprises a large part of undergraduate teaching, especially in relation to clinical epidemiology, and the early contribution of behavioural sciences, including medical sociology and health psychology, is encouraged and welcomed.

**Changes in curriculum delivery**

As passive absorption of didactically-delivered information has been replaced with active learning, based on curiosity and problem solving, so the teaching methods used to deliver today’s medical curricula have also changed. Integrated, problem-based curricula were piloted in sites in North America such as McMaster, and now form the core teaching methods of many universities, including Manchester26 and Liverpool.18 In Australia, six of the 11 medical schools use problem-based learning; the number of lectures has fallen substantially and the use of small groups, problem-solving workshops, and self-directed learning has increased correspondingly, sometimes with major implications for teaching resources and manpower.

There is evidence that students in a problem-based curriculum become better self-directed learners,27 that their confidence and feeling of belonging to the medical school increases, and that scores on some examinations could be higher. Some have suggested that, even if the acquisition of knowledge and clinical skills are not improved by problem-based learning, the work environment for students and teachers is much better. Concerns remain, however, about the amount of investment needed to achieve these outcomes.19 The size of the effect produced by a combination of problem-based learning and integration between basic and clinical sciences is difficult to establish, because either factors could be critical in determining the benefits of new curricula. The use of information technology and computer-assisted learning can, as described in a later article, complement the efforts of a limited teaching staff, but most schools moving towards a problem-based curriculum have noted that extra resources are required to deliver this type of learning effectively, and that the skills needed by teachers might be in short supply.

In the Netherlands, both traditional and problem-based curricula are taught in response to pressure from the government to reduce overloaded curricula, and to create more attractive and active forms of teaching. Modular, integrated courses based on small, problem-based learning groups, are common in the first 4 years. Some schools also make extensive use of simulation techniques to help students master professional skills; the medical school of Limburg, Maastricht, has had a leading role in the development and application of these active learning strategies.28

**Implementing curricular change**

The challenges of implementing and sustaining curricular reform are well recognised and have been described in a number of studies. At the University of Washington, for example, “curricular drift” developed 5 years after a major curricular reform, with both basic scientists and clinicians showing regression to the mean in terms of re-introducing teaching topics, and expanding teaching time, partly in response to financial pressures. At the University of Trondheim, Norway, the introduction of a problem-based medical curriculum, implemented in 1993, was also compromised by what is described as a high degree of autonomy of the individual faculty members and resistance to radical change, resulting in a hybrid model of learning methods. Staff participation and ownership of change are important if new methods are to be successfully implemented.

The Robert Wood Johnson Foundation created the Generalist Physician Initiative (GPI) in USA, aimed at modifying curricula to encourage medical graduates to enter generalist careers. Evaluations from a number of centres are beginning to appear, and there is evidence that significant changes in medical curricula have been instituted and sustained.29 There is evidence, too, that student satisfaction, especially related to patient-centred integrated clinical medicine in the early years of the curriculum, is improved and that critical thinking and problem-solving skills are enhanced. The WK Kellogg Foundation’s Primary Care Curricular Change Initiative, in 27 schools in North America, has also led to major curricular change that has been sustained. Intended outcomes, including, for example, the development of multi-disciplinary instruction and teaching in the community have occurred. Both of these initiatives provide examples of educational changes in response to new patterns of the delivery of medical care.
Faculty development is of crucial importance in creating and sustaining curricular change, and could be described as the enhancement of educational knowledge and skills of faculty members so that their educational contributions can extend to advancing the educational programme rather than just teaching within it. This definition clearly has many facets, including the willingness to promote and accept change, to apply continuous quality improvement in medical education, and to make a sustained commitment to curriculum delivery. Complex issues of funding, career tracks, and academic and institutional rewards are at play here, with different incentives operating in different academic and health-care settings, where it could be more or less difficult to provide individual, departmental, or institutional financial and other incentives to reward teaching commitment and quality.

Undergraduate and postgraduate curricula

The concept of a spiral curriculum in which topics are visited and revisited at time intervals, at different levels of intensity, and often with a different emphasis—eg, basic science, pathology, clinical science—has been important in curriculum design in many schools, and also in understanding the relation between undergraduate teaching and postgraduate training. A medical course designed to produce a “stem” or “pluripotential” doctor is followed by a programme of specialist or generalist training, leading to accreditation and qualification for a more focused role in medicine. There is, therefore, a reciprocity between the undergraduate and postgraduate years. With the development of an undergraduate core curriculum, for example, some topics that could be of great importance in primary care might need greater emphasis in postgraduate training and, conversely, changes in the requirements of postgraduate specialist medicine could have implications for the basic curricular content of the undergraduate years.

Achieving change

Medical education is changing rapidly, and many challenges remain for the future. Leadership of change is essential; balancing the need for academic stability, to build up a core of respected and skilled teachers, is at the centre of effective curriculum reform.

Feedback from students and patients is critical. Students will not know initially that they have to face and many parts of the curriculum, clearly vital, will often seem unpopular, so that excellent communication between staff and students is essential. A feedback loop from the ultimate stakeholder, the patient, is also central if difficulties of poor communication, arrogance, and medical error are to be ameliorated.

High-quality medical education is central to high-quality medical care. The need to ensure the continued production of doctors fit to practise medicine in the 21st century has major implications for medical schools around the world, who will all have to work hard to ensure that the curriculum does not lag behind the challenge. Rigorous evaluation of curriculum reform and educational interventions will always be required if we are to be certain that we are doing the best that we can for our students and our patients.

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The uses of error: Missed opportunities

Wanda was a 22-year-old physical education major in college, who came to see me because she thought she had a mass in her axilla. I had not seen her before but her parents were my patients and had urged her to make the long trip from her home town to the university hospital. She had no other symptoms and try as I might I could not convince myself that I felt a mass in her axilla. So I asked her to come back for another examination in 3 weeks.

I sent Wanda off with expressions of reassurance and concern: enough reassurance, I hoped, that she would not worry needlessly and enough concern that she would surely come back. But in the days that followed, I was ill at ease. Why would such a robust, carefree young woman come such a long way to see me? Could she not detect subtle abnormalities in her own body better that I could? Had my special interest in lymphadenopathy made me over-confident in my examination skills? But gradually, she slipped from my attention, replaced by a succession of other patients with other problems.

I next saw Wanda 10 weeks after the initial visit. 10 weeks, not 3! By then she had an obvious mass in her axilla and although she still felt well, both she and I were concerned. A biopsy showed a lymphoblastic lymphoma, and a team of cancer specialists took over her care.

My initial plan had been sound enough but it had not worked well. What had gone wrong? At first I blamed her for the delay in follow-up. Had I not told her clearly when I wanted to see her again? Then I blamed myself for not keeping her in mind. I should have checked whether she made the 3-week appointment or noticed when she did not keep it. Later, I concluded that systems—in this case, an alert for missing or cancelled patients—determine whether routine things get done, more than individual physicians’ determination to try harder and do better. Since then, I have participated in putting such systems in place.

As it turned out an earlier diagnosis would not have changed her clinical course. Wanda’s tumour was found during initial staging to be widely disseminated and extranodal. It progressed rapidly and responded only briefly to aggressive chemotherapy. She died just 8 months after her first symptom, despite heroic efforts to control her disease. Lymphomas of this particular histological type are systemic from the beginning—or, at least, do not progress from local to systemic disease in a way that could be cured by early diagnosis. Doctors, including me, tend to believe that if the outcome is bad there must have been something they could have done differently. If it is well established by research that we could not have changed the prognosis, we should not be so hard on ourselves. It may even deter us from examining our mistakes carefully.

I visited Wanda and her parents in the hospital shortly before she died. Others were in charge of her care and in any case nothing was working, so I felt terribly ineffective. I spent what seemed like an awkward few minutes with them making small talk. After she died, Wanda’s parents told me how much that visit had meant to her and to them. I was reminded how much a doctor just showing up, armed only with caring, means to frightened patients. I had not visited her nearly as much as I should have, but now I am better about not missing opportunities with other patients whose situations are medically futile.

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