function directly. Butter and colleagues[7] have shown that the biventricular lead system can reduce the threshold for cardiac defibrillation by 50%. This system delivers an auxiliary shock to an area of myocardium (lateral left ventricle) where, otherwise, the strength of the shock field produced by a single right-ventricular lead is low. Interestingly, this area of myocardium has also been reported to be an effective target for left-ventricular pacing in failing hearts.[8]

How might these data influence the development of ICD technology and the care of patients? Testing of the defibrillation threshold is routine at the time of implantation of the defibrillator, with a target safety margin of at least 10 J between the threshold and maximum output of the device output. Although this safety margin is based more on common sense and prudence than on solid evidence from clinical studies, it remains an accepted standard of care.[9] In those few patients in whom the safety margin is low, manipulations are used to lower the threshold.[10]

In the 20 years since the introduction of ICDs there has been a steady reduction in the energy required to terminate ventricular fibrillation. This reduction in defibrillator threshold has been achieved by improvements in electrode design, use of the generator as an active electrode, and use of biphasic configuration of the shocking wave. Further reduction in threshold can be achieved by variation of lead position and polarity and by addition of subcutaneous patch electrodes or electrodes in the superior vena cava. Butter and colleagues' study[7] suggests that placement of an additional left-ventricular defibrillation lead through a cardiac vein could be a very useful means of lowering the threshold if necessary.

Lowering of the defibrillation threshold has already led to a shift from use of epicardial patches requiring thoracotomy to much simpler transvenous therapy. Could further decreases of the threshold make the ICD reliable enough for implantation without need for testing of the threshold at the time of implantation? Such a development would be an important advance, simplifying implant procedures and removing the need for anaesthesia. The complexity of positioning an additional lead in a distal branch of a cardiac vein makes the concept of routine ICD implantation without threshold testing currently impractical. However, technological advances in the placement of the cardiac venous leads over the next few years will make further reductions in defibrillation threshold likely.

Reduction of the threshold in modern ICDs has other benefits—it increases the likelihood that a given shock will terminate ventricular arrhythmia, it may shorten charge time by reducing the energy that has to be delivered, it may decrease myocardial damage secondary to shock (especially with defibrillation shocks), it may increase the life of the device, and it may reduce the size of the device.

The ICD is evolving from an instrument for stopping ventricular fibrillation to one for the management of heart failure. The convergence of technology for defibrillation and for biventricular pacing is another step on this path. More and more, myocardial dysfunction, with or without overt arrhythmia, will become the prime indication for ICD. The cost of the device remains a barrier. Simplifying implant procedures with devices that have such low defibrillation thresholds that they do not require threshold testing or anaesthesia could be also a step toward reducing ICD costs.

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Market forces in public health

Developing countries under intense pressure to expand trade, and therefore markets, in health care are turning to the WHO for advice about the risks of trade policies for traditional public-health objectives. Of primary concern is the new round of talks, started by the World Trade Organisation's (WTO) Doha agreement,[1] to compel all 144 member countries to progressively open all services, including health care, to market forces under the General Agreement on Trade in Services (GATS). The process, known as liberalisation, begins in earnest in June this year when countries will be faced by liberalisation requests from other WTO members to which they will have to respond by March, 2003. Developing countries in ACP (Africa, Caribbean, Pacific) also have to deal with the European Union's Cotonou Agreement, an economic agreement between Europe and the developing world that requires negotiations on new trading arrangements to begin in September, 2002.[2] It is EU trade policy to target, for market access, the health-care systems of non-EU countries,[3] while US trade-policy targets health services in Europe and Latin America.[4]

The difficulty these countries have to confront is that opening essential services to competition carries well-known risks for the poor because access to services is usually sustained through public monopolies.[5] Many of these countries are already in the throes of market-oriented health-care reforms required by the International Monetary Fund and the World Bank in return for foreign investment (see p 1359). Elimination of market-entry restrictions on private firms and health-care corporations (liberalisation) brings an end to these monopolies and to the cross-subsidisation that characterises integrated public health-care systems.

In January, 2002, the WHO responded to developing countries' requests for advice by convening a meeting between WTO trade officials, the Organisation for

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Economic Co-operation and Development, and health experts to discuss the research challenges presented by increased trade in health care. However, in a sign that the WHO is under pressure to stress the benefits of trade rather than its drawbacks, Andrew Cassels, the WHO's head of Health and Development, opened the January meeting with the instruction that the research agenda should avoid the question of whether "liberalisation is good or bad" and concentrate instead on "how to get evidence for tough political decisions". Health experts and health officials tabled research proposals specifically targeting for evaluation the implications of private provision and foreign direct-investment for the goals of universality, comprehensiveness, and equity. But pro-trade delegates responded by calling on the WHO to provide itself with a mandate for trade in health services and to affirm the benefits of market mechanisms in the delivery of public services. These calls come at a time when the WTO is coming under growing pressure from some of its members to assess and demonstrate the welfare benefits of trade treaties such as GATS and TRIPS (Trade-Related Aspects of Intellectual Property Rights).

The WHO's stance on markets and privatisation has for some time given cause for concern. Its World Health Report 2000[6] has been criticised for ignoring the fragmentation of risk pools and erosion of entitlements resulting from privatisation of funding and delivery and for its pro-market orientation (a risk pool is a mechanism for sharing risks and costs of services across groups in society).[7] Yet with health-care policy increasingly determined internationally, there is a growing need for a properly funded international body for health policy with clear and explicit health objectives. The WTO is purely concerned with trade, and while the World Bank is now the largest international financier of health activities, with a lending portfolio in 1996 of US$13·5 billion dwarfing a WHO budget of US$400 million,[8] it is also committed to market-oriented reform.

The WHO constitution states "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition". The WHO must now actively assert this gold standard for universal health in its advice to all countries seeking help with trade commitments. One way ahead would be for it to promote tried and tested non-market-orientated models in health-care systems and a research agenda capable of scrutinising the impact of market mechanisms on access to health care. Its ultimate aim should be the development of intercountry cross-subsidisation methodologies which will work towards the promotion of global universal health care.

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Science and myth

In recent weeks the argument over the teaching of creationism as a credible scientific theory and as an alternative to evolution has reappeared in both the UK and the USA. The UK Prime Minister, Tony Blair, has refused to criticise the teaching of creationism as part of science in a state-sponsored school. In the USA, creationists have produced an alternative theory to evolution—intelligent design—which concedes that evolution might have occurred, but argues that because the products are so complex, there must therefore have been some overseeing presence. In Ohio, USA, proponents of intelligent design are now insisting that this idea should be taught as science alongside evolution in public schools.

Creationism has no rightful place in science lessons. This would not be an assault on religious freedom, as creationists have claimed. As Bruce Roberts, president of the US National Academy of Sciences, explains in *Science and creationism*, "science and religion occupy two different realms in human experience".[1] But to teach creationism as part of a science curriculum is absurd, simply because there is no credible scientific evidence for it. By contrast, many thousands of papers published in peer-reviewed scientific journals support the theory of evolution.

Intellectual laziness is the most charitable explanation for not accepting the evidence for evolution. The idea that a benevolent deity oversaw the making of the universe is easy, whereas scientific explanations can be difficult to understand—even the vocabulary may be unfamiliar. However, the evidence for how the solar system developed from a mass of gasses, how animals evolved from single cells to the complex species of today, and how even now species change in response to environmental pressures is far more compelling than the idea that the world was made by a deity in a week.

This debate comes at a time of deep public mistrust of conventional science and medicine with individuals increasingly turning to weird medical therapies such as homoeopathy or crystals, which lack any rational basis. Scientists and journalists must both take some of the blame for this mistrust and misunderstanding of science. Those who receive public funding should be obliged to explain to the public what they do and why they do it. Journalists should report stories rigorously, indicating where a theory has a valid basis and where it is based on poor evidence or anecdote alone. Until the public understands the basis for scientific theories, and the process by which these theories are validated it will be unable to distinguish science from quasi-science.

Above all, politicians should recognise and promote the importance of sound scientific theories in schools and in society at large. If they do not, they will not be able to lead the public debate on important scientific issues, such as stem-cell research and cloning. It is hard to understand how a constructive debate could happen in societies whose leaders give equal weight to science and myth.

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1 Science and creationism: a view from the National Academy of Sciences, 2nd edn. 1999: http://books.nap.edu/html/creationism (accessed on April16, 2002).

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