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Unleashing Science and Technology for Disease Control

A Global Perspective Would Benefit Developing Countries

Increasingly rapid advances in science and technology have saved or extended the lives of millions of people worldwide. But industrialized and developing countries have not shared the gains equally: People living in dire poverty in developing countries still lack access to basic care that could prevent or cure diseases and other health conditions. In the second half of the 20th century, a steady accumulation of knowledge in medicine and public health led to remarkable successes in controlling communicable diseases such as smallpox. These advances also resulted in better management of noncommunicable diseases such as heart disease and diabetes, particularly in industrialized countries. Much of the developing world now faces the dual challenges of addressing diseases related to poverty—undernutrition and infectious diseases—while also seeing a rise in the diseases that afflict wealthier countries.

To improve health in developing countries, a balance must be struck between relying on new medical advances and applying conventional health measures in cost-effective ways. In addition, health research must adopt a more global perspective: Greater cooperation between the industrialized countries of the North and the developing countries of the South will be essential to ensure that new scientific advances benefit poorer countries as well as wealthier ones.

Rapid Health Gains in the 20th Century

Progress in science and technology, along with social and economic changes, brought about dramatic health improvements in the second half of the 20th century. One of the major achievements was partial control of communicable diseases, for which scientific medicine is largely responsible. The highlight was the global eradication of smallpox by 1977. In addition, the widespread use of vaccines (now licensed for 29 common communicable diseases) and antibiotics has greatly reduced childhood and other diseases, resulting in increased life expectancy worldwide.

The scientific research that led to these health gains included advances in:

- Clinical epidemiology (the study of the causes, distribution, and control of disease in populations), which has enabled researchers to use increasingly sophisticated statistical methods to study disease patterns and develop better responses;
- The identification of risk factors for major diseases, which has allowed the health profession to focus on a relatively small number of behaviors (such as smoking, unsafe sex, and overeating) that account for a large share of deaths worldwide;
- The use of randomized controlled trials, which assign participants randomly to a treatment group or a control group that receives usual care, enabling researchers to measure health improvements from a specific intervention; and
- The increased acceptance of evidence-based medicine, in which research results are interpreted and used to develop good clinical practices.

The major achievements of scientific medicine of the 20th century have had limited effects on health in developing countries, however. The shortcomings are partially due to poverty and weak health systems, but they also stem from a bias in research toward solving the health problems of wealthy countries. Of the 1,233 new drugs that were marketed between 1976 and 1999, only 13 were approved specifically for tropical diseases that afflict mainly developing countries.

Health in Transition: Changes in the Pattern of Diseases

In industrialized countries, where major communicable diseases and childhood killers have been almost eliminated, scientific advances have increasingly focused on managing noncommunicable diseases and conditions, particularly

heart disease, cancer, and diabetes. Increased use of high-technology medicine, however, has led to spiraling costs and unprecedented growth in health spending. As the populations of these countries grow older and use more health care, the problem of containing health costs will become even more acute.

The rapid development of high-technology medical practice has incurred huge costs—dwarfing those associated with preventive medicine—both in industrialized countries and in higher income developing countries. In all countries, reducing people’s exposure to risk factors should gain greater priority over the use of increasingly high-technology medicine to control disease.

Many developing countries are caught between two worlds, grappling with undernutrition and infectious diseases on the one hand, and the diseases of wealthier countries—diabetes, hypertension, and heart and lung diseases—on the other. The growing use of tobacco and rising obesity in developing countries only exacerbate this problem.

The global pattern of disease will change dramatically by 2020, with heart and lung disease, depression, and injuries replacing communicable diseases as the predominant health problems of developing countries. These countries are also likely to experience the spiraling health costs currently facing industrialized countries as more people seek and use expensive curative care.

Priorities for Future Research

Several priorities should guide future biomedical research (see examples in the box below). First, the balance of research between industrial and developing countries should shift so that a greater proportion is directed at the needs of poorer countries. Public and private funding in industrial countries has predominantly supported research on diseases affecting their own populations and ignored the health problems of developing countries. This skewed funding has resulted in the “10/90” gap, in which more than 90 percent of the world’s spending on health research is directed at diseases that affect only 10 percent of the world’s population. If a better balance is not achieved, advances in science and technology could further widen the gap in health care between the North and South.

A second priority is to analyze and use methods of health care delivery already known to be clinically effective and cost-effective. Health services should be based on well-designed

pilot studies rather than political guesswork, and health care systems should be evaluated rigorously and held to high performance standards.

A third priority is to use a multidisciplinary approach—examining the biological as well as social dimensions of diseases—to address the major causes of death and ill-health that have yet to be controlled. The target diseases include malaria, AIDS, tuberculosis, cardiovascular disease, cancer, diabetes, and mental health disorders.

HEALTH TECHNOLOGIES FOR THE FUTURE

Recent developments in biological and biomedical research have enormous potential to improve and even revolutionize health care. For example:

- Advances in molecular and cell biology, including understanding the human genome and using DNA technology, have enormous potential to prevent and control diseases, though they are still far from clinical practice.
- Stem cell therapy, in which cells from embryos or adult tissue are used to make exact copies, may eventually allow surgeons to replace damaged tissues (or organs) with healthy ones.
- Changes in hospital practices may lower health-care costs by using minimally invasive procedures for diagnostics and surgery. An example is robotic surgery, where robots assist a surgeon in performing a procedure.
- A better understanding of fetal development could lead to changes in obstetric care to reduce premature births or enhance the development of preterm infants.
- Advances in neuropsychiatry, such as using imaging techniques to detect dysfunctions in the brain, can lead to more effective treatment of depression and other mental health disorders.
- The use of genetically modified crops could improve food supplies, nutrition, and the health of whole communities.

Moving Toward a Global Network for Research

Ideally, pharmaceutical and other health-related companies should shift their emphasis in research and development toward solving the health problems of poorer countries, rather

than problems affecting primarily industrialized countries. Governments in industrialized countries might offer tax advantages or other incentives to encourage such a global view. But because progress in this direction is likely to be slow, the health community should move more quickly to form a virtual global network for research that would bring together the research agencies of industrialized and developing countries. To accomplish this, researchers need to advocate for a greater proportion of overseas aid to be directed toward developing North-South partnerships for health research.

A number of such partnerships have already been formed. The British Wellcome Trust has supported partnerships between Oxford University and institutions in Asia and Africa that have been sustained for over 20 years, conducting research and training local health professionals. Plans are now being developed for South-South partnerships, in which countries with expertise in particular areas of health can form partnerships with others lacking in facilities and expertise. Institutional partnerships are a cost-effective way for universities in richer countries to help those in poorer countries.

“A major program of education on the global problems of disease is needed at every level, including governments, industry, universities, charitable organizations, and all others involved in health research. If the scientists of the future are trained with a more global perspective on health and disease, it can form the basis for sustainable capacity building and research programs between the North and South.” --Professor Sir David Weatherall, Weatherall Institute of Molecular Medicine, Oxford, UK.

To bring about a more global perspective on health, some fundamental changes are needed, such as:

- Educating the public and increasing scientific literacy through more dialogue between scientists and the community;
- Reorienting university studies, particularly in schools of medicine and public health, toward a more global focus;
- Educating governments and industries on global health problems;
- Encouraging more partnerships and incentives to address the problems of poor countries; and
- Increased funding from all sources for global health research.

The attitudes of the funding agencies (governmental and nongovernmental) that support health research need to change to direct a greater proportion of funds toward addressing the diseases of the developing world.

Conclusions

Research in basic human biology and the biomedical sciences is entering an exciting phase. It is impossible to predict, however, when the explosion of scientific knowledge will become available to prevent and treat the world's major diseases. Thus, health research must strike a balance between expanding proven, cost-effective approaches in health care and applying discoveries in completely new fields of science.

Priorities for health research include examining the causes and prevention of noncommunicable diseases, as well as developing more effective strategies to control the most common and intractable communicable diseases. Most developing countries will soon encounter (if they haven't already) the major killers in industrial countries. Learning more about those killers' basic causes, prevention, and management is therefore crucial.

The international health community must make a major effort to educate governments, international agencies, universities, and the private sector on global health problems. If universities and other institutions adopt a more global perspective on health, they can help establish networks for health research programs benefiting both the North and South.

For More Information

David Weatherall, Brian Greenwood, Heng Leng Chee, and Prawase Wasi. 2006. “Science and Technology for Disease Control: Past, Present, and Future.” In *Disease Control Priorities in Developing Countries*, 2nd ed., ed. D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills, and P. Musgrove, 119-38. New York: Oxford University Press.