This year marks our 50th anniversary as a nonprofit volunteer health organization. With more than 4 million volunteers, the American Heart Association (AHA) is the largest nongovernmental organization dedicated to cardiovascular disease and stroke. Since the AHA began in 1948, its mission has been fighting death and disability from these diseases through research and education. In research, the AHA focuses on identifying and providing initial support to talented, young investigators and disseminating scientific discoveries to scientists, physicians, and other healthcare professionals through our 5 journals and scientific programs such as these Scientific Sessions. The medical community, as well as the public, is the target audience of AHA’s educational efforts to promote prevention and early treatment of cardiovascular disease and stroke.

The Scientific Sessions attracted more than 30,000 scientists and other healthcare personnel from 54 nations. The impressive representation of the international community is the clearest sign that cardiovascular health is regarded as a global challenge at the turn of the century. For this reason I salute the following 5 presidents and representatives of the world of cardiology: Dr Lars Ryden, President of the European Society of Cardiology; Dr Sjukri Karim, President of the Asian Pacific Society of Cardiology; Dr Mario Garcia-Palmieri, President of the Inter-American Society of Cardiology; Dr Antonio Bayes de Luna, President of the World Heart Federation; and Dr Spencer B. King, President of the American College of Cardiology.

In the past 50 years, the AHA has made great strides—a source of great pride to all of us. But at the turn of the century, the AHA and indeed the world of cardiology face several serious challenges: (1) How will we support and energize research, which is so crucial to preventing the still-evolving epidemic of cardiovascular disease and stroke? (2) Is it realistic to expect that this epidemic can be lessened or avoided solely by professional and public education, or is there a need for more aggressive implementation strategies? (3) Would a more integrated and cooperative approach, involving many if not all of the national and international organizations represented at these Sessions, maximize the effectiveness of individual organizations and their volunteers?

What is the basis for these 3 challenges? Is an epidemic of cardiovascular disease and stroke indeed still evolving?

Epidemic of Cardiovascular Disease and Stroke

As a direct result of research sponsored by the AHA and the National Heart, Lung, and Blood Institute, and certainly as a consequence of professional and public education, fewer people are dying of cardiovascular disease and stroke in the United States. A comparison of mortality data from 1973 and 1993 reveals that the decrease in deaths is most apparent in coronary heart disease among young and middle-aged people, regardless of their race or sex1 (Figure 1). According to recent data from the Atherosclerosis Risk in Communities Study, such favorable trends are in large part a result of improvements in acute treatment and subsequent secondary prevention.2 In reality, however, the severe impact of cardiovascular disease and stroke on mortality has only been postponed for a few years.3,4 That is, people are living longer after having suffered a heart attack or stroke or being diagnosed with hypertension or another form of cardiovascular disease. Thus, they are dying of these diseases but at later ages.1,4–6

As a result, despite steady progress in treatment, in the United States as well as in many other countries, cardiovascular disease and stroke remain by far the number 1 cause of death for both men and women of all ethnic backgrounds. In 1995, 455,000 men and 505,000 women died of cardiovascular disease and stroke. That year, 281,000 men and 256,000 women died of cancer, the second leading cause of death (Figure 2).
But no less important, cardiovascular disease and stroke cause the greatest disability. In the United States alone, more than 10 million people are alive today with these diseases, which cost the nation approximately $274 billion each year in medical expenses and lost productivity (Table 1).

By the year 2020, coronary heart disease and stroke will hold first and fourth places, respectively, in the World Health Organization’s list of leading causes of disability7 (Table 2). In 1990, pneumonia was the world’s leading cause of disability, while heart disease and stroke ranked fifth and sixth. On the basis of these and other indications of an evolving worldwide epidemic of cardiovascular disease and stroke, we have no alternative but to advance toward the future with renewed dedication to meet each of the three challenges outlined above.

**Challenge 1: Research as a Resource**

Recently, governments in the United States, Canada, Europe, and East Asia have been unanimous in recognizing that “science is an endless and sustainable resource that pays extraordinary dividends,” and “a strong science base is essential to the welfare of a nation’s economy, intellectual culture, and quality of life.”8–14

**Funding: Magnitude and Scope**

A strong science base cannot exist without research funding that is sufficient in magnitude and scope. For that reason, the AHA and Research America!, of which AHA is an active member, has campaigned for the doubling of the National Institutes of Health’s (NIH) budget over the next 5 years. In the United States, Congressional support in both the House of Representatives and the Senate—triggered in part by the voices of nonprofit health organizations such as the AHA—recently resulted in the largest increase in federal research funding in this country’s history. In fiscal year 1999, the budget of the NIH will increase by 14.7%, or $2 billion more than the previous year’s level, to an annual total of $15.6 billion15 (Figure 3).

Even the doubling of the NIH budget cannot ensure that cardiovascular and stroke science will be adequately funded. Thus, public and private funding, especially that funneled through nonprofit volunteer health organizations such as the AHA, must continue and indeed increase, and most likely will do so at least in the United States, where the concept of “giving” is treasured and the concept of a “tax exemption” is a facilitator16,17 (Table 3).

The AHA’s current annual research budget totals approximately $127 million—6% of the NHLBI budget. The AHA’s

**TABLE 1. Cardiovascular Disease and Stroke Disability**

<table>
<thead>
<tr>
<th>Survival Category</th>
<th>No. of People, Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CV disease</td>
<td>10.2</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>7.9</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.2</td>
</tr>
<tr>
<td>Other</td>
<td>1.1</td>
</tr>
<tr>
<td>Cost Burden, $</td>
<td></td>
</tr>
<tr>
<td>CV disease</td>
<td>274 billion/y</td>
</tr>
<tr>
<td>Heart disease</td>
<td>175 billion/y</td>
</tr>
</tbody>
</table>

CV indicates cardiovascular. Data from the CDC and AHA, 1998.
research programs have a sharply focused scope. One of the association’s goals is to identify and provide initial support to the most promising young investigators as they embark upon productive science careers that will be sustained by permanent grant support.

With regard to the scope of funding, to succeed, these young investigators—and indeed all researchers today—must function effectively in a more scientifically integrated environment. That environment does not yet exist but is urgently needed. It has been said that attempts to categorize scientific research as either basic, clinical, or applied is usually inaccurate and represents a major error in policy.18 Our challenge is to integrate basic and applied science, foster group collaboration, and bring together funding from government, industry, public or private corporations, and individuals to meet the changing needs of society.19,20 The task before us is simply too great to allow divisiveness of purpose or diffusion of our goals.

Priorities: Research and Training

The magnitude and scope of research funding needed in cardiovascular disease and stroke require the AHA and NIH to set specific priorities for their research programs and training strategies. Anticipating that the NIH budget could be increased significantly, the leaders of the NHLBI wisely began a process 10 months ago to identify the research priorities and training strategies that should be implemented over the next few years. This process has included a group of non-NIH scientists, with several key representatives of the AHA. The members call themselves the SPARK group, because the goal has been to spark new ideas for research.

The plan developed by SPARK (Table 4) recognizes the continuum that exists through the various disciplines, from genetics, to cell biology, to integrative physiology, to phenotype of disease, to populations, and to health. The efforts of all these disciplines must be aimed at translating basic science into health benefits.20,21 Among the approaches to enable this translation must be the development of new modalities to train investigators at centers of excellence, whether these centers are local or integrated with other distant centers. Efforts are also needed to secure longer periods of financial support for the investigators’ projects. Other enabling approaches include the dissemination of new technologies derived from the human genome project, computational biology, imaging for earlier and noninvasive detection of disease, and enhancing the epidemiological and statistical methodology available for population studies and clinical trials. Such integration of disciplines and enabling approaches will lead to the generation of focused research in such areas as vascular immunobiology, tissue genesis and organ genesis, or gene-gene and gene-environment interactions.

---

**TABLE 2. Global Burden of Disease Study**

(Compiled from WHO–World Bank) 7

<table>
<thead>
<tr>
<th>1990</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pneumonia</td>
<td>1. Heart disease</td>
</tr>
<tr>
<td>2. Diarrheal diseases</td>
<td>2. Major depression</td>
</tr>
<tr>
<td>3. Disease in newborns</td>
<td>3. Traffic accidents</td>
</tr>
<tr>
<td>4. Major depression</td>
<td>4. Stroke</td>
</tr>
<tr>
<td>5. Heart disease</td>
<td>5. Chronic lung disease</td>
</tr>
<tr>
<td>7. Tuberculosis</td>
<td>7. Tuberculosis</td>
</tr>
<tr>
<td>8. Measles</td>
<td>8. War</td>
</tr>
<tr>
<td>10. Birth defects</td>
<td>10. HIV</td>
</tr>
<tr>
<td>11. Malaria</td>
<td>11. Diseases in newborns</td>
</tr>
</tbody>
</table>

*Projected leading causes of DALY (disability-adjusted life-year)

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**TABLE 3. Magnitude of Public and Private Funding for Biomedical Research (in $US Millions)**

<table>
<thead>
<tr>
<th>Country</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>12 800</td>
</tr>
<tr>
<td>Germany</td>
<td>2990</td>
</tr>
<tr>
<td>Japan</td>
<td>1200</td>
</tr>
<tr>
<td>France</td>
<td>726</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>438</td>
</tr>
<tr>
<td>Italy</td>
<td>350</td>
</tr>
<tr>
<td>Canada</td>
<td>181</td>
</tr>
<tr>
<td>Switzerland</td>
<td>134</td>
</tr>
<tr>
<td>Netherlands</td>
<td>82</td>
</tr>
<tr>
<td>Sweden</td>
<td>64</td>
</tr>
<tr>
<td>Australia</td>
<td>62</td>
</tr>
<tr>
<td>Belgium</td>
<td>52</td>
</tr>
<tr>
<td>New Zealand</td>
<td>13</td>
</tr>
</tbody>
</table>

---

**TABLE 4. From Genes to Health and Health to Genes**

Genes⇒Cell Biology⇒Tissue Biology⇒Integrated Physiology⇒Phenotype⇒Population⇒Health

Enabling approaches

Training centers/secure support
Genomics technologies
Computational biology and emerging technologies
Imaging
Population studies and trials

Vascular immunobiology
Gene-gene/environment and functional genomics
Tissue genesis/organ genesis

Research on cardiovascular disease and stroke, as well as in other medical sciences, requires innovative approaches to training. New NIH grants supporting clinical research training include 400 Career Development Awards for young physicians (K-23); 400 awards for early- or mid-career investigators to help them train the next generation of investigators (K-24); and 20 institutional clinical research awards to develop formal curricula for training clinical researchers (K-30).

Other examples of efforts to identify and train young scientists include the commitment of 3% to 5% of the research budget by the National Research Council of the National Academy of Science to develop science teachers in precollege programs; a National Science Foundation program for the development of technology for learning science at colleges, and the Kellogg Commission project for learning science locally or at a distance by university undergraduates.

Personal Commitment to Research
The magnitude and scope of research funding and the need to realign priorities for research and training are not the only significant challenges facing the scientific community. Another challenge is to maintain a strong personal commitment to research. Success in science, as in any other discipline, has always required maturity and dedication.

When, upon self-searching, a young scientist comes to realize that a particular field of research “is what I am good at” and turns to me for advice, I recommend that he or she enjoy the fulfillment of that special talent and pursue the scientific discipline in depth. “The harder you work, the luckier you will get.” is another important piece of advice, together with “luck favors only the prepared mind,” and “take time to think.” Every talented young scientist needs an outstanding and committed mentor. Indeed, it has been said that scientific directors should be rated in terms of mentorship of junior investigators just as they are on their own research productivity.

Challenge 2: Education and Implementation
The second challenge facing cardiovascular and stroke research is whether it is realistic to expect that this epidemic of cardiovascular disease and stroke can be modified only through professional and public education, or whether there is perhaps a need for more aggressive implementation strategies.

On June 27, 1998, the AHA’s Delegate Assembly approved the ambitious impact goal of reducing coronary heart disease, stroke, and risk by 25% by the year 2008. Two strategies will be critical in meeting that goal: prevention targeted at high-risk individuals and populations, and earlier acute treatment of heart and stroke events.

Prevention Targeted at High Risk
High-risk populations, with clinically manifested coronary or noncoronary atherosclerosis or with subclinical atherosclerosis, bear the greatest risk of adverse events (Figure 4). Therefore, an aggressive preventive approach offers the most benefit in these groups. (However, as shown in the Eastern Finland Study, a modest 10% reduction in serum cholesterol levels in lower-risk populations can have a huge total impact because of the very large number of people in these populations.)

To be most effective with a disease-prevention strategy aimed at high-risk populations, we must educate health professionals and patients with diagnosed cardiovascular disease, including hypertension, because it is such a major risk factor for stroke. Perhaps most important to reducing deaths and disability in the high-risk populations is a supportive healthcare system geared to aggressively implementing secondary prevention strategies.

The 1996 Bethesda Conference identified at least 6 barriers to implementing effective preventive measures (Table 5). Two involved professional factors: a lack of incentive or reimbursement for physicians and a lack of time to adequately carry out prevention activities. Two barriers involved patient education: a lack of knowledge or motivation and inadequate access to preventive care. Two other problems involved health-system support: lack of reimbursement for prevention services and facilities and a lack of sound policies and standard guidelines.

While education of professionals and the public is important, the greatest chance for successful implementation will probably be the result of partnerships between health centers and managed healthcare organizations. The National Committee on Quality Assurance, which is responsible for setting the standards of care for managed care organizations, is working with the AHA to develop the new Health Employer Data and Information Set criteria for the care of patients with risk factors for cardiovascular disease and stroke. These guidelines, which will require strict documentation of physicians’ implementation of prevention and risk reduction in each at-risk patient, should lead to a positive impact on managed-care reimbursement for medical services.

### TABLE 5. 27th Bethesda Conference Barriers to Implementation of Prevention

<table>
<thead>
<tr>
<th>Physician</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of incentives and reimbursement</td>
</tr>
<tr>
<td>Lack of time</td>
</tr>
<tr>
<td>Patient</td>
</tr>
<tr>
<td>Lack of knowledge and motivation</td>
</tr>
<tr>
<td>Lack of access to care</td>
</tr>
<tr>
<td>Health system (practice, hospital, community)</td>
</tr>
<tr>
<td>Lack of resources and facilities</td>
</tr>
<tr>
<td>Lack of policies and standards</td>
</tr>
</tbody>
</table>
Early Treatment

The second strategy to be implemented by the AHA is to improve early treatment of heart and stroke events.

The National Heart Attack Alert Program, which was launched by the NHLBI in 1991 with the goal of rapidly identifying and treating individuals with myocardial infarction, is partly responsible for the 30% decline in door-to-needle time for initiation of thrombolytic therapy that occurred between 1992 and 1995 (Figure 5). According to data from the National Registry of Myocardial Infarction, the median door-to-needle time was 60 minutes during the first half of 1992. During the last half of 1995, median time had decreased to 39 minutes. Similar efforts have been launched by other organizations, such as the European Society of Cardiology and the European Resuscitation Council. Of interest, recent information from community programs in the United States suggests that such education strategies also have a significant impact because of the increased number of patients with myocardial infarction who present in emergency rooms.

The AHA is broadening its efforts to increase the percentage of patients who receive prompt, appropriate treatment after experiencing cardiac arrest, acute myocardial infarction, or stroke (Table 6). If the AHA succeeds, by the year 2003, 20% of victims of cardiac arrest will be effectively resuscitated within 6 minutes, 20% of patients with acute myocardial infarction will be treated in <1 hour, and 90% will be treated within 6 hours. The AHA also plans to implement programs that will increase to ≃20% the number of people who suffer a stroke who will be treated in <3 hours. However, if these goals are to be met, it is critical that improvements occur in public awareness of the warning signs and symptoms of these conditions and in access to emergency care.

Challenge 3: National and International Cooperation

The third and final challenge is: Would a more integrated and cooperative approach involving many if not all of the national and international organizations represented at these AHA Scientific Sessions maximize the effectiveness of the individual organizations and their volunteers? Streamlining our own organizations and, importantly, thinking more cooperatively and internationally will allow our organizations to be more effective. As cardiovascular disease and stroke climb to the top of the list of the major causes of death and disability in the rogue’s gallery of the World Health Organization, our organizations have no choice but to cooperate and collaborate across borders and continents. The need for global extension also applies to research as a resource and education with implementation of prevention and early treatment, with individualization from country to country depending on socioeconomic and cultural factors.

Despite differences in the magnitude and scope of research funding from one country to another, a spirit of cooperation among government, industry, and individuals should be fostered wherever feasible by tax policies that encourage investment in biomedical research. Research priorities must be thoughtfully distributed across the spectrum of disciplines, from molecular genetics and cell biology to the phenotypical realm of human disease. The enabling elements of scientific training, technology sharing, population-based epidemiology, and clinical trials form the basis for advances in cardiovascular medicine but must be made specific for the needs of each country, culture, or population. However, it must be stressed that quality control of investigators is as essential in

![Figure 5. National Heart Attack Alert Program for initiation of thrombolytic therapy, founded by NHLBI in 1991, is believed to be in part responsible for decrease in median time “door to needle” (vertical axis) between 1992 and 1995 (horizontal axis). Information obtained from National Registry of Myocardial Infarction (NRMI 1 and 2), 1998.](image-url)

**Table 6. AHA Acute-Care Treatment Cardiac Arrest, Myocardial Infarction, Stroke**

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Time From Onset of Symptoms to Treatment</th>
<th>% of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac arrest</td>
<td>&lt;6 min</td>
<td>20</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>&lt;1 h</td>
<td>20</td>
</tr>
<tr>
<td>Stroke</td>
<td>&lt;3 h</td>
<td>20</td>
</tr>
</tbody>
</table>

*AHA Delegate Assembly, June 27, 1998.*
science as in any other endeavor and will ultimately determine productivity. For example, the recent strict scrutiny with new surveillance guidelines of the investigators at the Max Planck Institute in the technologically advanced nation of Germany is in a way paralleled by the critical review in progress of investigators at the National Academy of Science of a country such as China.

The challenge for professional and public education, as well as implementation of prevention and early treatment, particularly in developing countries, is immense. A critical issue is the wide disparity in health spending in developing nations, currently aggravated by the world market fluctuations, which represents a dense barrier to public health. The World Health Organization, the World Bank, and other international organizations must work to diminish the disparities in public health that have their origin in economics. Beyond international organizations, this is a matter of public ethical responsibility.

What will it mean for the United States or for the AHA if the battle against the tobacco industry is “won” but, because of lack of cooperation with or interest in the health of the less developed countries, the tobacco industry is able to find new and easy markets in these countries? What will it mean for leading pharmaceutical companies to produce, on a grand scale, vaccines against cancer or even potent weapons against cardiovascular diseases if economically accessible vaccines for respiratory diseases, lethal diarrheal illness, tuberculosis, and malaria cannot be delivered as well?

It is indeed our ethical responsibility to find ways to apply the advances that will directly or indirectly benefit everyone. And it is hard to imagine how this global reality can be ignored by the AHA and by our colleagues in the many professional medical organizations today.

Conclusions

Despite the accomplishments of the past 50 years, heart disease and stroke remain an alarming epidemic. Therefore, we must look toward the future with renewed and passionate dedication to research, education with aggressive implementation, and cooperation with an international perspective. I believe that with such dedication, we may succeed in preventing cardiovascular disease and stroke from becoming the number one global burden.

References


Key Words: cardiovascular disease ■ stroke ■ epidemic ■ American Heart Association
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