INTRODUCTION

Biomedical Research and the Environment

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The evidence continues to grow in support of the concept that human health is linked closely to the environment in which we live and work. Scientists agree that as environmental quality deteriorates, harmful health effects are inevitable. Recognizing that the issues are challenging and complex and that we need a source for the best scientific information available to educate ourselves on environmental matters, the National Association of Physicians for the Environment (NAPE), with 58 cosponsors, held a Leadership Conference on Biomedical Research and the Environment at the Natcher Conference Center of the National Institutes of Health (NIH) in Bethesda, Maryland, on 1–2 November 1999. Scientific experts and leaders came together to consider the theme of environmental stewardship because we believe we have a major opportunity to prevent pollution in medical research and clinical laboratories and thereby protect the health of people and the environment. Anticipating a doubling in the Federal funding for medical research, and consequently an increase in energy use and in the types and volumes of waste materials (solid, chemical, medical, pathological, and radioactive) that will require management and appropriate disposal, we believe there is an urgent need to address two important questions.

First, how can the environmental health and biomedical research leadership develop a program of pollution prevention and energy efficiency to prevent this enormous growth from creating serious increases in pollution that will be deleterious to the health of our patients?

Second, how can such a program have spin-off uses for other scientific research areas for which increased funding also will be available?

The information presented at the leadership conference emphasized sustainable development, best greening practices, and environmental stewardship in biomedical research laboratories. Many leaders in the scientific community recognize that environmental stewardship is a theme symbolizing the important effort to provide an integrated, synthesized and concerted effort to protect the health of the environment now and in the future. We recognize a need for a central organization to evaluate, promote, and oversee efforts in environmental stewardship, and an immediate place for a central database/clearinghouse that would facilitate information transfer regarding the best laboratory practices to protect the biomedical research environment.

We must begin by acknowledging that academic biomedical research has environmental impacts on our air, water, agriculture, and quality of life. The community of talented scientists has the experience, knowledge, and innovative talent to have a positive influence on environmental health at local, national, and international levels. Although biomedical researchers have not traditionally embraced environmental health regulations and safety issues and have at times encountered local environmental health and safety officers and the myriad external regulatory agencies in an adversarial context, we are now forced to think of ourselves as environmental stewards and to move in the direction of cooperation and compromise and to seek the best practices available to deal with environmental issues.

The concept of environmental stewardship implies that decision-makers take a broad view that extends beyond merely meeting minimum standards and avoiding legal liabilities. Agencies charged with the responsibility of enforcing safety and environmental regulations must move beyond the outmoded policy of "one size fits all" and must seek specific solutions that promote sustainable design and development of the biomedical research infrastructure. A growing body of information supports the premise that buildings can be constructed in a manner that will improve their functional and environmental performance. Cooperation between the U.S. Environmental Protection Agency (EPA) and the Federal Energy Management Program of the U.S. Department of Energy (DOE) to develop the concept of "Labs for the 21st Century" (Labs21), as well as the work of the National Academy of Sciences, will contribute to our understanding of effective approaches and techniques of laboratory construction and renovation.

At the conference, a number of speakers who have been leaders and strong supporters of environmental health issues gave their views about how environmental stewardship in biomedical research could best be advocated and structured.

One of the authors, Byron J. Bailey, Fellow of the American College of Surgeons and president of NAPE, explained the reasons for holding the conference and indicated how the concepts underlying it were developed. He commented that NAPE determined at last year's national meeting that the major focus of efforts the coming year would be the development of a conference and an action program relating to biomedical research and the environment.

NAPE has had a very close connection with NIH over the years. In virtually every activity NAPE has undertaken, leaders of NIH have had a prominent role. That was the case in the initial founding conference (*1*), in the conference on Air Pollution Impacts on Body Organs and Systems (*2*), in the conference on Water Pollution and Health (*3*), and in the leadership conference last year.

The basic ideas for the conference were spelled out in an editorial (*4*) in *Environmental Health Perspectives,* the scientific journal of the National Institute of Environmental Health Sciences (NIEHS), by John Grupenhoff, executive vice president of NAPE. He began to realize the implications of the potential doubling of funding for the NIH and its extramural grantees over the next 5 years and the possibilities for improved environmental stewardship in the medical research field.

If congressional leaders can double the NIH budget in 5 years, it means an additional nearly $100 billion will be dedicated to the nonprofit medical research enterprise, with a continuing buildup thereafter. It is likely that funding for biomedical research portfolios in other Federal agencies will also increase. These funds will cause a major economic boom in nonprofit biomedical research, and it is expected that for-profit company expenditures in research will increase greatly as well. Companies providing research equipment and supplies will also participate in that expansion.

We are likely to see increased expenditures for new construction at university, college, and independent research center campuses, including upgrades and new laboratory and office equipment—all with more efficient energy use implications. There will also be a significant increase in the types and

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volume of wastes (solid, hazardous chemical, medical pathological, radioactive, and multihazardous) that will require management and appropriate disposal. The question is, how can the biomedical research leadership, with its environmental health, public health, and policy colleagues, develop a program of pollution prevention and energy efficiency to prevent this enormous growth in the biomedical research enterprise from creating increases in pollution deleterious to human health and to the environment? How can such a program have spin-off uses for other scientific research areas for which funding will also be available?

It was decided by the NAPE board of directors that there be a four-part program throughout the year to deal with these issues. A national program should be developed with the following components:

- A national conference to highlight the issues, profile current best practices, and suggest methods of implementing environmentally sound practices, including those in the entire research supply chain that would require each link in the chain, from raw material provided to manufacturer to user, to improve environmental performance.
- Following the conference, a national education and training program should be developed to promote environmental soundness at university and college campuses and research facilities that receive biomedical research grants, combining the efforts of researchers and facility managers.
- Development of a clearinghouse to inform the field of best practices available.
- Development of a research agenda, both for the improvement, use, and disposal of biomedical research materials, and for building design and construction of research facilities, including energy efficiency and development of standards for healthy building designs.

Kenneth Olden, director of NIEHS, set the tone for the conference in his welcoming address. Dr. Olden stated that on the threshold of a new century it is important to develop a national program of pollution prevention and energy efficiency in biomedical research. With every major shift in public thinking, there has always been a significant initial event. For example, the first green wave of environmental consciousness in this country in the 1960s was triggered by the outstanding work of Rachel Carson, *Silent Spring* (*5*). Earth Day 1970 was another triggering event that marked both the culmination of years of growing environmental concern and the start of a new era of environmental protection. Although the accomplishments in environmental protection since the celebration of the first Earth Day in 1970 have been remarkable, continued progress will require new ways of thinking, new public policies, new science, and new technologies. Dr. Olden predicted that in 30 years this conference will also be viewed as a triggering event. It will be the event that triggered the greening of biomedical research.

Although NIH is proud of its commitment to environmental stewardship on its various campuses in the Bethesda, Maryland area, Research Triangle Park, North Carolina, and other locations, we recognize that it is important to promote environmental protection throughout the research enterprise supported by the various institutes of NIH. NIH can work with universities, public interest groups, and industry to develop waste minimization programs with respect to use and generation of hazardous products. Environmental protection and pollution control are becoming increasingly more complex. Issues such as land use; agricultural and urban runoff; indoor air pollution; use of motorized vehicles; use of pesticides, herbicides, and fungicides by homeowners; waste disposal by small businesses; and development of biotechnology industry pose difficult and challenging decisions that cannot be remitted with technologies and policies designed to control point source emissions in the early 1960s and 1970s.

This conference has triggered the call for stewardship of biomedical research, including environmental management, green accounting, environmental auditing, and recycling. Of the thousands of products in use today in our field, all emit pollutants during production, transport, application, or disposal. The proper control of these pollutants was the focus of this conference.

Paul G. Rogers, gave the charge to the conference. Mr. Rogers, a former member of Congress, for many years chairman of the Subcommittee on Health and the Environment of the U.S. House of Representatives, and now an attorney, has worked hard and relentlessly for increased support for NIH.

Mr. Rogers presented the following conference challenges:

- How can we best involve the medical research community, especially the large extramural research community and its allied organizations, in a national effort to understand the nature, size, and extent of difficulties and opportunities regarding medical research and its relation to the environment, and especially the opportunity for improving environmental soundness of its activities?
- How can we work to develop a national education and training program, operating at the university and research campus level, combining the environmental interests of researchers and their campus colleagues who are facility managers, that is, those charged with building and maintaining research and educational facilities?
- How can we develop an Internet clearinghouse of best practices, available anywhere, and especially from the extramural community, to speed the introduction of new techniques for environmental improvement and to make our work more environmentally sound?
- How can we work with other colleagues in the private sector, especially in pharmaceutical and life sciences companies and other areas of research, to bring this education and training program and Internet clearinghouse into action and to improve their practices as well?

U.S. Surgeon General David Satcher gave his views about how this effort could relate to public health. He opined that a balanced research agenda means asking important questions. One of the most important features of the conference was the attention given to important questions such as, As we invest in biomedical research in the future. What are we saying about the environment? What are we saying about prevention? But also more than that, What are we saying about helping to eliminate disparities in health? We know that even though minorities constitute about 25% of the population in this country, 40% of the people who live within 2 miles of hazardous waste sites are minorities, and an even greater percentage are children. So we face a situation in which the people who sometimes benefit most from the research are not the same ones who are exposed to the greatest hazards from that same research and who suffer the greatest consequences because of where they live. So the concern of this conference was certainly consistent with Healthy People 2010 and with what Dr. Satcher now sees as major priorities for the future in terms of eliminating disparities and working toward a balanced research agenda. In addition to NIH, that balanced research agenda will have to include the Agency for Health Quality Research, prevention research, and the prevention centers funded by the Centers for Disease Control and Prevention.

Former Senator Lowell Weicker Jr., former chair of the Senate Subcommittee on Labor-Health and Human Services-Education Appropriations, which funds NIH, worked to provide major increases in NIH funding while in the Senate, and now chairs the Pew Environmental Health Commission, provided further insights and challenges facing environmental scientists.

He noted that in the last two decades, scientists have been noticing a sharp increase in the number of illnesses and deaths that may be linked to pollution and other environmental factors.

Causes of disease, including potential environmental factors, must be investigated further. Unfortunately, we are hindered by the lack of basic scientific tools, resources, and policies to adequately protect the public from environmental threats.

Every search for answers must be born from a body of knowledge. Obtaining that knowledge effectively and efficiently can best be done by developing a centralized, national tracking system—centralized, not a dozen different independent agencies. Our nation has a substantial health care infrastructure already in place. We must make a national commitment to make it more robust, to make an investment so that researchers know how our children are dying, the origins of the diseases, and what must be done.

On paper, in terms of our investment, we spend much more on cures than on preventive measures, yet no one doubts that prevention, including pollution prevention, is by far the more economical way to go. Although not in any way diminishing the efforts of all the institutes at NIH and in universities across the country, one of the changes that must take place in terms of science is to bring prevention to center stage.

Both genetic and environmental agents interacting with each other over the course of many years cause human illness. This necessitates that the country invest not only in improving our treatment of diseases but also in preventing chronic diseases. That is the goal of the Pew Environmental Health Commission—to develop a set of recommendations for strengthening our country's public health system so we can have better defenses, better answers, and better actions toward preventing environmental health harms.

William Raub, deputy assistant secretary for science policy and former acting director of the NIH, commented that we want to ensure that the biomedical research engine we depend on to deal with environmental health problems is not itself a contributor to those problems. He focused on one topic—namely, regulation of laboratory waste.

He noted that the regulations developed primarily for industrial production were being applied to the research laboratories and testing laboratories. In the research laboratories there are generally small if not minute quantities of waste; in industry much more substantial amounts are generated. Research and testing laboratories often use a wide variety of substances with varying degrees of hazard; each industry uses a much less wide variety. Finally, by their nature, research and testing are environments of constant and sometimes even mercurial change, whereas industrial production tends to be much more predictable and stable over a longer period of time. Nevertheless, we have the Resource Conservation and Recovery Act (*6*); the regulations of the Occupational and Safety Health Administration, the Department of Transportation, and the states; and local codes for fire and other hazards impacting in a "one-size-fits-all" mode.

Although the answer to the dilemma seems obvious, i.e., make something safer, cheaper, and otherwise better for the environment, in recent years the idea has continued to bubble, and Dr. Raub observed with pleasure that in a number of states, and through Project Excel of EPA, a number of efforts are again addressing this issue. In the EPA-sponsored case, three universities—Boston College and the University of Massachusetts at Boston in Boston, Massachusetts, and the University of Vermont in Burlington, Vermont—the states of Massachusetts and Vermont, and the EPA are joined in a collaborative project with the overall goal of developing performance-based rules more tailored to laboratories than to the industrial setting. In the interim this project is focused on such specifics as a 10% reduction in hazardous waste generated in these laboratories, a 20% increase in the amount of waste recycled and reused, and better listing and control of the numbers and types of hazardous substances in the laboratory environment.

The conference keynoter, John E. Porter, chair, Subcommittee on Labor-Health and Human Services-Education Appropriations, U.S. House of Representatives, who has been the chief advocate for doubling the NIH budget in 5 years, remarked that he was very optimistic that a second 15% increase for NIH will be achieved for FY 2001. If this is accomplished, this will facilitate the same strong commitment for the subsequent 3 years, achieving the doubling of NIH funding over 5 years. This presumes a strongly expanding economy that allows these types of increases.

This massive increase in activity could have negative environmental impacts, such as increased types and volumes of hazardous wastes, with potential pollution effects, and increased energy use, which might result in air and water pollution. Why are we concerned with any of that? Primarily because of its negative effects on human health!

The theme of the organizer of this conference (NAPE) is "Pollution Prevention is Disease Prevention." Would it not it be a great irony if, as NIH-funded research expanded greatly, the biomedical research enterprise and the health care industry in America ignored the environmental matters resulting from this expansion and caused pollution that could negatively affect human health?

What is needed is a biomedical research environmental ethic involving all research activities and all those engaged in research or fields related to research. Standards should be established for facilities, equipment, waste disposal, and research procedures. Each of us has a personal environmental ethic. We should also have one for our work.

Rep. Porter considered that the conference was the place to pull it all together and itemized the assets available to achieve the goals. There are 58 sponsoring organizations, 13 of which are NIH institutes and centers. Each of these organizations can work to develop environmental soundness programs with their own constituencies as well as working with the overall effort.

For this conference, 10 committees were organized, composed of representatives from the participating organizations. These committees have focused on the development of environmentally sound facilities, including construction, renovation, energy, and pollution prevention. This means healthy buildings and green auditing of biomedical research facilities as well as community outreach to inform neighbors of the sound actions research facilities are taking.

Another major committee effort has focused on the minimization and management of wastes from biomedical research. Here, the Howard Hughes Medical Institute (HHMI) in Chevy Chase, Maryland, has been at the forefront of developing a program to deal with this issue.

Committees have also dealt with the education and training of personnel, including the dissemination of best practices by means of an Internet clearinghouse. Regions III and IV of the EPA have agreed to supply the electronic platform for an Internet website devoted to this program. Obviously these best practices have to be scientifically sound, workable, effective in preventing pollution, and, at the same time, save money. Given the superb work of the National Library of Medicine in electronic information systems, how could it participate in the effort? In addition, this should not be an effort of the Bethesda campus alone but should also be developed by researchers in the extramural community. The Association of Higher Education Facilities Officers has pledged that its members on 1,900 higher education campuses will work on this matter with research administrators and university officials across the country.

Beyond the 58 organizations, EPA has begun work on improving energy efficiency and pollution prevention in Federal laboratories, of which there are nearly 20,000.

In promoting energy efficiency in health and research facilities, use of lighting figures prominently. In some research facilities, lighting accounts for 60% of energy use. By simply installing energy-efficient lighting, working conditions could be improved for researchers while reducing overall energy use.

Other assets include nongovernmental organizations. The National Wildlife Federation (NWF) has brought the issue of environmentally sound scientific research to the attention of its thousands of student activists. They will be promoting the integration of environmental conservation into scientific research on their campuses and research facilities in all states.

Professional associations have also taken up the cause. The American Hospital Association (AHA) has signed a memorandum of understanding with EPA to create a program of Hospitals for a Healthy Environment.

What about involving the patient advocacy groups? The pharmaceutical and biotechnology companies?

Rep. Porter concluded that there exists the beginning of an apparatus to carry out the kind of program necessary to expand biomedical research without compromising the environment. Standards need to be created and coordinated, and there need to be review mechanisms.

His charge to the conference participants was to address how NIH, its institute leaders, its extramural grantees, and intramural program, together with the convenors and cosponsoring organizations of this conference, support and develop a long-term program of energy efficiency and pollution prevention in scientific research. How can a formalized biomedical research environmental ethic be developed? Should these be voluntary programs and standards, or should there be some regulatory mechanism?

Mark Van Putten, president and chief executive officer of the NWF, spoke about opportunities for campus environmental stewardship. The NWF has worked with students, faculty, and staff to implement conservation projects at 1,800 colleges and universities since the founding of the NWF Ecology Program in 1989.

He observed that biomedical research campuses have enormous power to help redirect these trends. This influence extends beyond environmental health research, into practical, day-to-day decisions about what to buy and how to construct and maintain buildings. With or without an increase in NIH funding, it is important to green biomedical research campuses.

Collectively, the 3,700 colleges and universities in the United States spend over $186 billion every year. If NIH funding increases, as much as $30 billion will be spent annually on new biomedical research facilities and supplies at campuses. This is considerable leverage through contracting, bidding, and specification processes in selecting everything from architects to lighting, office equipment, and laboratory supplies.

He feels strongly that biomedical research and health departments on campuses can make a significant positive difference on these fronts, often saving a good deal of money in the process. We have seen how science buildings have implemented retrofit plans to vastly improve energy efficiency and reduce CO_2 emissions. Mercury pollution has been reduced when universities used mercury-free thermometers and other lab equipment. There are also numerous examples of how biomedical research campuses have reduced solid waste and prevented unnecessary chemical purchases.

We know we cannot win the battle for a healthy environment if ecological sustainability is not a cornerstone of all teaching, operations, and research. If common-sense conservation values are not reflected in higher education, who will be the standard-bearer?

W. Emmett Barkley, director of laboratory safety, HHMI, reported on activities already underway to improve management of hazardous waste in academic research institutions.

It is the philosophy of the institute that research of the highest standards can best be conducted in laboratories where the commitment to environmental health and safety is exemplary. This ideal is actively promoted among the institute's host institutions and throughout the world scientific enterprise.

One example of the institute's leadership role is its sponsorship of a project to develop best practices for managing hazardous wastes in major academic research institutions. The HHMI Office of Laboratory Safety is leading the project. Ten HHMI host institutions are participating. In August 1999 a workshop (*7*) was held at the HHMI Headquarters and Conference Center in Chevy Chase, Maryland, to develop the project's scope, objectives, criteria, and approach. Directors of the environmental health and safety programs at the 10 universities and their state regulatory colleagues participated in this workshop. Representatives from NIH and EPA were also participants. The group reached consensus on the project plan.

The scope of the project includes a broad collaborative initiative to identify and establish consensus best practices for managing hazardous wastes in major academic research institutions, and develop a proposed regulatory model for implementation at the state or Federal levels. Participants in the project will include staff of the environmental health and safety programs and members of the scientific research community at the 10 HHMI host institutions, along with officials from the 10 state environmental protection agencies.

There are four project objectives:

- To develop an operational strategy for managing hazardous wastes generated in teaching and research laboratories of major academic research institutions. Consensus best practices that are relevant to laboratory activities, practical to carry out, efficient, and cost effective will be established. The strategy will also promote excellence in environmental stewardship among students, laboratory employees and other workers, and scientists and academic leaders.
- To demonstrate the efficacy of the strategy for managing hazardous laboratory wastes.
- To promote cooperation, understanding, and mutual respect between environmental protection agencies, academic institutions, and the scientific research community.
- To develop a plan for implementing best practices for managing hazardous wastes.

There are three criteria guiding the project: *a*) all hazardous wastes leaving academic research institutions for treatment, storage, or disposal will comply with current EPA and state regulations; *b*) agreement that current EPA or state regulations will not constrain the development of best practices for managing on-site hazardous wastes generated in teaching and research laboratories; and *c*) all discussions will be governed by the commitment to minimize the potential of harm to human health and the environment and to promote excellence in environmental stewardship.

A full day of discussion at the August workshop in both plenary sessions and small work groups led to the agreement that seven key elements should be addressed in developing a hazardous waste management plan for academic research institutions. These principal elements are *a*) executive commitment, *b*) a specific management plan, *c*) responsibility and accountability, *d*) policies and procedures to minimize waste, *e*) standard operating procedures, *f*) training, education, and communication, and *g*) continual evaluation and improvement.

The 10 institutions will independently identify best practices for managing hazardous wastes. The environmental health and safety director from each institution will organize and lead a work group to carry out this effort. Members of each work group will include representatives from the institution's academic research community, the environmental health and safety staff, and representatives from the state regulatory agency. Each work group will identify best practices for their institutions that are relevant to laboratory activities, practical to carry out, efficient, and cost effective. Their work will not be constrained by either current EPA or state regulations or existing institutional policies or practices. For example, many institutions have already developed what they consider the best strategy for complying with current

regulations. The best practices identified as part of this effort, however, will be governed only by a genuine commitment to minimize the potential of harm to human health and the environment and to promote excellence in environmental stewardship. It is conceivable, therefore, that the best strategy for achieving compliance with current regulations will have no relevance to the best practices identified as part of this project.

A second workshop was held at the HHMI Headquarters and Conference Center on 29 February and 1–2 March 2000 to develop the consensus best practices for managing hazardous wastes in academic research institutions (*8*). The consensus best practices were drawn from the reports prepared by the 10 work groups. Invited participants at this workshop were the environmental health and safety directors who led the work groups at the participating institutions, and one scientist and one state regulator from each of these ten groups. Representatives from NIH, EPA, and EPA Region 1 Laboratory Project XL will be invited to participate in the workshop. The participants also developed an implementation plan for demonstrating the efficacy of the consensus best practices for managing hazardous wastes. The implementation plan will include a regulatory model to fit the consensus best practices. This plan will be used to encourage Federal and state sponsorship of demonstration projects.

Ted Schettler, co-chair, Human Health and Environment Project, Greater Boston Physicians for Social Responsibility, reported on Health Care without Harm (HCWH), The Campaign for Environmentally Responsible Health Care.

HCWH, established in 1996, is a coalition of over 240 member organizations in more than 16 countries whose mission is to reduce the public health and environmental impacts of the health care industry without compromising patient safety or care. The campaign was developed in response to the observation that medical waste incinerators are among the leading sources of environmental dioxin and mercury emissions. Each of these environmental contaminants represents a threat to public health and wildlife at current exposure levels. Nearly all mercury-containing materials in health care institutions can be substituted with nonmercury alternatives. Dioxin emissions may be substantially reduced by replacing polyvinylchloride (PVC) with non-PVC alternatives where available, removing PVC from the waste stream, eliminating nonessential incineration, and maximizing combustion conditions when incineration cannot be avoided. Altered purchasing practices and materials reuse and recycling minimize the volume and toxicity of the waste stream. Waste segregation minimizes the volume of regulated medical waste and optimizes recycling opportunities, leading to substantial savings in disposal costs. HCWH has developed numerous educational and training materials designed to help community members and those working within the health care industry reduce the adverse impacts of the health care system on public health and the environment.

Some legal/policy initiatives include *a*) successfully pressured EPA to strengthen medical waste incinerator regulation; *b*) produced model state regulations for medical waste incinerators; *c*) created the conditions for the AHA to enter into an agreement with EPA to reduce the volume of medical waste and to phase out mercury and persistent bioaccumulative toxicants from 6,000 hospitals by 2005; *d*) fostered development of the Alternatives Clearinghouse and website at the University of Massachusetts, Lowell, Massachusetts; *e*) developed shareholder resolutions' Interfaith Council on Corporate Responsibility (ICCR) that led to Memorandum of Understanding (MOU) between ICCR and Baxter; and *f*) similar agreements with Kaiser, Universal Health Services, and Tenet. International activities include *a*) pressured the World Bank to reconsider their support of medical waste incinerators in India; *b*) developed alliances with groups in 16 countries; particularly active in India with assistance and training programs; *c*) HCWH Europe established September 1999.

Lara Sutherland of the Massachusetts Executive Office of Environmental Affairs and Katherine Svedman of the AHA reported on the AHA's new program of environmental stewardship.

A 1998 MOU between the AHA and EPA has resulted in an ambitious project involving both signatories as well as many stakeholders. The main goals of the MOU are to virtually eliminate mercury from the health care waste stream by 2005 and to reduce the total waste volume by 33% in 2005 and 50% in 2010. This initiative, now called Hospitals for a Healthy Environment (H2E), will affect biomedical research facilities and allied industries as health care institutions implement environmental measures and bring this commitment to their suppliers and clinical partners. Biomedical researchers and research institutions can support the MOU by partnering with hospitals to reach the waste volume and toxicity reduction goals, using the tools developed by the project to reduce the environmental impacts of their own work, and encouraging hospitals to pledge their support to the initiative.

The AHA is an institutional membership organization of nearly 5,000 public and private health care facilities with an extensive state and regional chapter structure. The AHA was formed in 1906 and has since been involved in national public policy issues affecting health care. AHA and its affiliated Personal Membership Groups provide educational and professional services to thousands of hospital professionals across the country.

The MOU is a continuation of this commitment, and should provide much-needed technical assistance to AHA members as well as catalyze environmental excellence throughout the health care industry.

Biomedical research is an indivisible part of health care. Many hospitals host research facilities as an integral part of their patient care strategy and often house these research labs at the hospital. As hospitals improve the environmental performance of their clinical facilities through participation in the MOU, invariably they will be looking for ways to bring these concepts to all the departments of the hospital, including the research laboratories. Separate research institutions and biotechnology and pharmaceutical companies will also be affected by the MOU as the hospitals that are part of their clinical partnerships look for ways to bring their environmental commitments into their partnership agreements and supply chain. Many of the environmental issues facing hospitals are the same as those facing biomedical research labs: mercury use, increase in solid waste due to single-use devices and equipment, and generation of hazardous chemical and infectious waste. Tools generated by the H2E project may also be useful to research facilities as they implement best practices and waste reduction strategies.

Research institutions, biotechnology firms, and health care suppliers can participate in Hospitals for a Healthy Environment by forming alliances within the health care community to advance the H2E effort. This may entail working with specific clients to reduce waste or mercury use, or increasing research efforts that result in the availability of products that reduce solid and hazardous waste, or the use of mercury or other persistent, bioaccumulative, and toxic pollutants (PBTs). Research professionals, institutions, and programs can also encourage hospitals to pledge their support of Hospitals for a Healthy Environment through the pledge letter available from the AHA.

This landmark agreement between the AHA and EPA provides a mechanism and framework for all people and organizations involved in health care and biomedical research to come together to find and promote solutions to environmental issues that all of us face. Working together cooperatively, the entire health care community will be better able to reach these goals of virtual mercury elimination, solid waste reduction, and pollution prevention.

Romulo L. Diaz Jr., assistant administrator of EPA, with Philip Wirdzek, national energy manager, Facilities Management and Sciences Division, reported on Labs21, the new effort by EPA to improve the environmental performance of U.S. laboratories.

EPA and DOE recently launched Labs21, a voluntary initiative to improve the environmental performance of U.S. laboratories. Although the initiative is still in its formative stages, it focuses on improving laboratory energy and water efficiency. As the Labs21 energy- and water-efficiency focus gains wider acceptance, the Labs21 initiative will evolve to include even more aggressive pollution prevention goals and strategies unique to laboratory facilities.

The primary guiding principle of the Labs21 energy and water focus is that improving the energy efficiency and environmental performance of a laboratory requires examining the entire facility from a holistic, or comprehensive, perspective. Adopting this perspective allows laboratory designers, operators, and owners to improve the efficiency of the entire facility rather than improving the efficiency of specific laboratory building components. As Labs21 practitioners understand, improving the efficiency of individual components without examining their relation to the entire system can eliminate opportunities to make other, more significant, efficiency improvements.

As currently envisioned, Labs21 will focus on the following five activities:

- Creating a national database of current environmental practices, including energy and water consumption data for a variety of laboratory types. The data can be used to compare laboratory performance.
- Negotiating voluntary goals for laboratory environmental performance, including energy and water efficiency goals, with each potential Labs21 participant.
- Providing training or other opportunities to exchange technical information.
- Establishing partnerships with interested Labs21 participants.
- Promoting the Labs21 initiative.

According to EPA estimates, if only 25% of the nation's estimated 150,000 private and public research laboratories achieve energy-efficiency improvements of 60% (an efficiency gain less than that expected from efficiency projects being conducted in EPA facilities), then the United States could reduce its annual energy consumption by 84 trillion Btu, which is equal to the energy consumed by 840,000 U.S. households. This would save $1.25 billion in utility costs, reduce carbon dioxide emissions by 19 million tons, and remove the equivalent of 1.25 million automobiles from U.S. highways.

Other benefits of the Labs21 approach include *a*) lower laboratory utility and operating costs, *b*) reduced health and safety risks, *c*) improved facility management, *d*) reduced greenhouse gas emissions, *e*) elimination of waste and other inefficiencies, *f*) improved community relations, and *g*) lower insurance premiums.

Why focus on laboratories? The typical laboratory currently uses five times as much energy and water per square foot as the typical office building because of intensive ventilation requirements and other health and safety concerns. Examining energy and water requirements from the holistic building perspective promoted by Labs21, however, can identify significant opportunities to improve efficiencies while continuing to meet or exceed health and safety standards.

The leadership conference concluded that in order to enhance the prospect of success, new approaches for measuring research performance should include a mechanism by which incentives are provided to promote environmental stewardship at the level of the laboratory investigator. The themes of environmental stewardship and sustainable research should be articulated as policy objectives by Federal biomedical research leaders. Informational materials on best practices and green research techniques should be developed and disseminated widely to bench-level scientists.

The take-home message of these articles from the leadership conference is that environmental stewardship is an extremely important theme in the biomedical community that must be developed as an integrated, concerted effort to protect the health of the environment now and in the future. The concept of environmental stewardship must be brought into the planning and development stages of policies, programs, and facilities. New programs should be undertaken on behalf of the health and welfare of society as a whole and biomedical scientists must be given the information about environmental issues and encouraged to utilize such information in their daily investigative activities. First we must educate ourselves, then we must be committed to lead responsibly in environmental matters, and finally, we must encourage and support senior administrators in the biomedical research community in these efforts to protect the biomedical research environment.

Many of the papers presented at the conference can be accessed on the NAPE website (*9*).

References and Notes

1. National Conference on Physicians and the Environment, 23-24 February 1993, Washington, DC.
2. National Conference on Air Pollution Impacts on Body Organs and Systems, 18 November 1994, Washington, DC.
3. Water Pollution and Health Conference 21-24 May 1997, Chicago, Illinois.
4. Grupenhoff J. The environment and biomedical research [Guest Editorial]. Environ Health Perspect 106(12):A580 (1998).
5. Carson R. Silent Spring. New York:Fawcett Crest, 1964.
6. Through the Resource Conservation and Recovery Act (RCRA), the U.S. Congress provided the U.S. Environmental Protection Agency with the framework to develop regulatory programs to manage solid waste, hazardous waste, medical waste, and underground storage tanks.
7. The Howard Hughes Medical Institute sponsored a workshop on 23–24 August 1999 in Chevy Chase, Maryland, as phase one of a comprehensive project to identify and implement best practices for managing hazardous wastes in major academic research institutions.
8. The Howard Hughes Medical Institute HHMI) held a workshop on 29 February–1 March 2000 in Chevy Chase, Maryland, to complete the second phase of its collaborative initiative to develop and demonstrate consensus best practices for managing hazardous waste in academic research institutions.
9. The final manuscripts developed from this conference will also be available on the NAPE website (*http://www.napenet.org*).