Designing the 21ˢᵗ Century Hospital

Environmental Leadership for Healthier Patients and Facilities

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Health Care Without Harm is an international coalition of 440 groups in 55 countries working to transform the healthcare industry so that it is ecologically sustainable and no longer a source of harm to people and the environment. Since 1996, HCWH has been at the forefront of efforts to shift the healthcare sector toward safer, healthier products and practices. Major successes include: virtually eliminating the market for mercury fever thermometers in the United States; reducing the number of polluting medical waste incinerators in the United States from 5,000 in the mid-1990s to less than 100 today; shifting the medical-device market away from DEHP-containing PVC plastic; implementing the first green building system for hospitals, the *Green Guide for Health Care;* and working with hospitals to build markets for locally grown, sustainable healthy food. For more information, visit www.noharm.org.

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Foreword

The American healthcare industry is in the midst of an impressive construction boom, the result of diminished capital investment in new and replacement hospitals in the 1990s, the aging population, and the increasing number of hospitals experiencing bed shortages and capacity bottlenecks in their emergency rooms, surgical suites, and critical-care units. The forecast of annual capital spending on health facilities rising from $18 billion today to $35 billion in the year 2010 makes a discussion of better building important and timely.

This healthcare construction boom presents a rare opportunity to use the emerging sciences of evidence-based design, materials assessment methodologies, and green building tools to build healthier healthcare facilities that benefit occupants, communities, and the global environment.

Because they are responsible to the communities they serve and their environmental impacts span both operations and construction, healthcare organizations are in a unique position when it comes to being green. Since the mid-1990s, the industry has made considerable progress in reducing operational impacts and now stands poised to begin transforming design and construction practices. Moreover, as an industry that employs 1 out of 8 Americans, directly or indirectly, and drives upwards of 15 percent of the gross domestic product, the decisions that healthcare purchasers make can have a dramatic impact on the marketplace.

In the area of operations, the healthcare industry is cleaning up its own house, which serves to make healthcare organizations better community-health advocates. The industry has dramatically reduced reliance on medical waste incineration, which the Environmental Protection Agency (EPA) identified as the largest source of dioxin contamination in the atmosphere in 1996. Since that time, the number of medical-waste incinerators in North America has fallen from close to 5,000 to less than 100. The American Hospital Association signed a memorandum of understanding with the EPA with a commitment to phase out the use of mercury altogether. Many hospitals are beginning to advocate for chemicals policies and reduced use of antibiotics in food sources, as they respond to the growing evidence around linkages between the health of the environment and the health of the communities they serve.

With regard to sustainable building practice, the healthcare industry is slowly taking up the challenge and opportunities that green building presents. According to the U.S. Green Buildings Council, the number of LEED (Leadership in Energy and Environmental Design) registered healthcare buildings in the United States has risen from twenty, just two years ago, to more than eighty today. Moreover, there are more than one hundred healthcare organizations participating in the *Green Guide for Healthcare's* pilot program. This means that almost two hundred healthcare organizations in the United States are advancing green design, construction, and operational strategies for their facilities.

It is in the context of furthering this important dialogue that The Center for Health Design (CHD) and Health Care Without Harm commissioned the writing of these papers, which will be available for free download on the CHD website at www.healthdesign.org.

Individually, these papers tackle very different aspects of this complex, intricate, and compelling subject. But together, they represent an incredible opportunity to move healthcare from the status quo to becoming more responsible stewards of the environment.

Debra J. Levin
President
The Center for Health Design

First, Do No Harm

Gary Cohen

The challenge intrinsic to healthcare is how to provide high-quality treatment in an ever-changing environment. New science and technological innovations constantly require healthcare providers to transform the way they deliver services. Over the last ten years, the new science linking chemical contaminants in the environment and the incidence of disease has created an additional impetus for the transformation of healthcare practice. This paper explores the implications of this new science linking contaminants and health and discusses the environmental innovations that hospitals are implementing to not only create more optimal conditions for healing in their institutions, but also to prevent disease in the general public.

Our rising disease burden

Chronic diseases and disabilities now affect more than 90 million men, women, and children, more than one-third of our population (CDC 2005a). In spite of the many advancements in medical practice, the best available data shows an increase in the incidence of asthma, autism, birth defects, childhood brain cancer, acute lymphocytic leukemia, endometriosis, Parkinson's disease, and infertility (Trasande and Landrigan 2004, Jahnke et al. 2005).

Some of the highlights of Americans' disease burden are summarized below.

- The lifetime risk of getting cancer is 1 in 2 for men and 1 in 3 for women; 1 in 12 and 1 in 11, respectively, will develop invasive cancer before the age of 60 (ACS 2005).

- The risk of breast cancer has almost tripled from more than 1 in 20 to 1 in 8 in the last forty years (ACS 2005).

- Asthma rates doubled between 1980 and 1995 (Mannino et al. 2002).

- Non-Hodgkin's lymphoma has nearly doubled since the 1970s (RPCI 2005).

- In America, 127 million people are overweight; 60 million are obese (AOA 2006).

- Between 1997 and 2004, diabetes incidence increased 45 percent among 18-44 year olds (CDC 2005b).

- Endometriosis, linked to dioxin exposure, now affects 10 percent to 15 percent of the US female population (Holloway 1994, Suchy and Stepan 2004).

The picture is profoundly troubling. The human cost for families and communities is immeasurable, particularly those already disadvantaged by persistent economic disparities. The economic cost of these diseases by 2020 will exceed $1 trillion yearly in healthcare costs and lost productivity (Goldman 2001).

The new field of environmental health is linking each of these diseases and disorders to exposure to toxic chemicals (CHE 2006, Heindel 2003). The old way of looking at chemical risk and safety would have missed these links, as they are not as simple as single cause and single effect. But through the new lens

of environmental health science, we are learning that exposure to toxic chemicals, at levels thought to have been safe, is increasing the chronic disease burden of millions of Americans.

The new findings in environmental health science show that:

1. Chemical exposure at incredibly small levels can impact the hormonal system and disrupt the body's normal development, including interacting with genes that can damage the delicate balance in the human body. New science is revealing that genes and chemicals work together to contribute to disease onset.

2. Babies in the womb and young children are more vulnerable to chemical exposure than average adults.

3. Chemical exposure at important windows of human development can set in motion changes that only manifest themselves as health impacts later in life.

4. Chemicals can interact in a synergistic way in our bodies to contribute to a health impact or exacerbate a health problem.

This new science is coupled with the increasing understanding that industrial chemicals are present in our food, air, soil, water, homes, schools, workplaces, and even in our bodies. Our exposures come from food, cleaning and disinfection products, personal-care products, pesticide and herbicide applications, emissions from chemical manufacturing and disposal sites, pharmaceuticals, and a multitude of other sources, some known and some unknown.

In the past five years, the Centers for Disease Control and Prevention (CDC), has released three biomonitoring studies detailing toxic chemical loads among the American public. The CDC's "Third National Report on Human Exposure to Environmental Chemicals" looked at 148 environmental chemicals—including lead, mercury, cadmium, and other metals; dioxin, furans, and PCBs (polychlorinated biphenyls) and forty-two pesticides—in the bodies of thousands of participants (CDC 2005c). The conclusions are startling. Without our knowledge or informed consent, all of us carry the products and byproducts of the chemical industry—carcinogens, reproductive toxins, neurotoxicants, mutagens, and chemicals that impact a broad set of bodily systems.

In a biomonitoring study of umbilical cord blood of newborn babies, the Environmental Working Group detected 287 chemicals in all and an average of 200 chemicals in each child (EWG 2006). Of the 287 chemicals detected in umbilical cord blood, 180 cause cancer in humans or animals, 217 are toxic to the brain and nervous system, and 208 cause birth defects or abnormal development in animal tests.

In separate biomonitoring studies, EWG found two hundred chemicals in the umbilical cord blood of newborn babies (EWG 2006). In another study, Mount Sinai School of Medicine in New York, in collaboration with two nongovernmental organizations (Commonweal and Environmental Working Group) found an average of 91 industrial compounds, pollutants, and other chemicals in nine study volunteers. Seventy-six carcinogens were found among the participants, 94 nervous system toxicants, and 70 reproductive toxicants. A total of 167 separate chemicals, including dioxins, were found in the group. A companion website lists the chemicals found in each participant, which companies make or use those chemicals, and the products that contain them (EWG 2003).

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United States chemical companies hold licenses to make or import more than 75,000 chemicals for commercial use with approximately 1,500 newly synthesized chemicals annually registered by the federal government (EPA 2006c, Oleskey and

McCally 2001). Chemical production is rising and the resulting waste is mounting. According to the EPA, US industries reported manufacturing 6.5 trillion pounds of 9,000 different chemicals in 1998. In 2004, major US industries reported dumping 4.2 billion pounds of 650 industrial chemicals into our air and water (EPA 2004). This represents less than 9 percent of total toxic releases, since most toxic releases are not reported (NET 2004).

As a result of toxic products and pollution, every child born today already carries toxic chemicals in his/her body that have passed through the mother's placenta. We have minimal to no toxicological data on most of these chemicals. Additionally, there is almost no scientific research about the synergistic effects of exposing human beings to this complex cocktail of toxic compounds. And we also do not know how this body burden of chemicals interacts with ongoing exposure to emissions from factories, incinerators, food, air pollutants, and other sources, as well as other environmental stressors and genetic dispositions.

Healthcare's contribution to chemical contamination

Dioxin and mercury are two chemicals that new environmental health science has shown to be unsafe at levels previously thought benign (Mahaffey 2000; Keitt, Fagan, and Marts 2004).

According to the US Environmental Protection Agency (EPA), in 1995, medical waste incinerators were the largest source of dioxin air emissions and contributed 10 percent of the mercury air emissions in the United States (EPA 1995). Processes such as combustion, chlorine bleaching of pulp and paper, certain types of chemical manufacturing, and other industrial procedures that include the combustion of chlorine produce dioxin as a byproduct.

The EPA estimates that humans receive more than 95 percent of their dioxin intake through food (FDA 2006). People eat dairy products, meat, and fish and take the dioxin into their bodies, where it is stored in fatty tissue for years and builds up over time. Dioxin's global distribution means that every member of the human population is exposed. This is especially problematic for childbearing women, who pass dioxin to a child in utero and when breastfeeding. The EPA also estimated, in its 2003 Dioxin Reassessment draft, that the average levels of dioxin in all Americans is "at or approaching levels" where we can expect to see a variety of adverse health effects (EPA 2003). Health effects linked to dioxin exposure in humans and/or animals include cancer, endometriosis, testicular atrophy, increased miscarriages and birth defects, damage to the immune system, neurological damage, and alterations in hormone function. Dioxin is one of the most infamous of the persistent bioaccumulative toxins (PBTs), one of the most potent carcinogens known to science, and one of the few targeted by international treaty for elimination.

Intimately linked to the dioxin issue is polyvinyl chloride (PVC), used widely in the production of IV and blood bags, plastic tubing, and an array of other hospital products. PVC (because of its high chlorine content) contributes to dioxin formation when it is manufactured and incinerated. Flexible PVC often contains a chemical, DEHP (Di(2-ethylhexyl)phthalate) that can leach out of products and enter the bodies of patients receiving fluids through PVC tubing. In 2000, new environmental health science led the National Toxicology Program to conclude that DEHP is a reproductive toxicant and that infants in hospitals are at risk from exposure to this chemical (NTP 2000). The Food and Drug Administration followed with a health advisory to hospitals, urging healthcare facilities to seek safer alternatives, especially for vulnerable patient populations (FDA 2002).

Medical waste incinerators are also a source of mercury and other heavy metal emissions into the environment, although their numbers have been drastically reduced (EPA 1995). Mercury is a toxic metal that affects the human nervous system, liver, and kidneys; mercury-contaminated fish eaten by pregnant women can affect fetal development. In the United States, forty-two state departments of health have issued warnings against eating fish caught in all or some of their states' water bodies because of mercury contamination. The EPA estimates that 1.6 million pregnant women, children, and women of childbear-

ing age are exposed to unsafe levels of mercury from eating contaminated fish (EWG 1997). An estimated 630,000 newborns are threatened with neurological impairment due to in utero mercury exposure, or one in six children born in the United States (CDC 2003, Mahaffey 2004).

In addition to dioxin and mercury contamination, there are a variety of other environmental exposures in the hospital environment that can lead to compromised health for both healthcare workers and patients. Some of these issues arise from hospital design and materials used in building healthcare facilities. For example, 75 percent of PVC is used in construction, which outgases DEHP into the air. Four studies have linked interior PVC exposure to asthma (Thorton 2002; Jaakola et al. 1999; Jaakola, Verkasalo, and Jaakola 2000; Wieslander et al. 1999). Other exposures are tied to day-to-day hospital operations, such as the use of toxic cleaners and pesticides in healthcare facilities. According to research conducted by the Massachusetts Department of Health, poor air quality has been identified as the most frequent cause of work-related asthma in healthcare workers (Pechter et al. 2005).

Hospitals are also energy-intensive institutions. After the food-service industry, the healthcare industry ranks second in energy-usage intensity (DOE 2002). In 2005, each square foot of healthcare space cost an average of $2.15 in electrical and natural gas expenses (CEE 2005). Some of these costs can be addressed by energy-efficiency upgrades and smart design. Additionally, many hospitals are located in communities where public transit either does not exist or the hospital is inaccessible to the public transit system. Until recently, hospitals paid little attention to the energy performance and efficiency of their building infrastructure.

As the environmental and health effects of global warming become more pressing, healthcare, like other major sectors, will need to reduce overall energy use and move to cleaner energy sources. Indeed, they have a responsibility to do so.

Pharmaceuticals are also emerging as another major environmental and public health threat that until recently was virtually unknown. Many pharmaceuticals contain hormone-disrupting chemicals, which migrate from hospitals and homes to water bodies, negatively impact aquatic life, and wind up in our drinking water (Fox 2005, Heinzmann 2005). Additionally, many drugs contain compounds that are persistent in the environment or bioaccumulate in the food chain. As more drugs are consumed by Americans, more of these biologically active agents are building up in our environment. More than one hundred pharmaceuticals or their metabolites have been found in water bodies in Europe and the United States, some of them in drinking water supplies (Hemminger 2005, Heberer et al. 1997).

Evolving the Hippocratic oath

Since physicians and other healthcare professionals take an oath to "First, do no harm," healthcare institutions and the industries that support them have a special responsibility to ensure that their operations are not major sources of chemical exposure and environmental harm. But, until recently, healthcare professionals and hospital administrators were unaware of their contribution to chemical contamination and broader societal disease burdens. The educational curriculum for physicians, nurses, and hospital administrators does not provide the latest scientific information on the environmental consequences of healthcare delivery.

In the last ten years, however, the information gap has begun to close. The healthcare industry has begun to expand its definition of health to include environmental health—the body of scientific evidence that links the health of the environment to the incidence of human disease. With the emergence of Health Care Without Harm (HCWH), hospital leaders have learned about their industry's contribution to chemical exposure issues and made steady progress to solving some of their environmental problems. For example, due to the rising costs of complying with dioxin emission regulations and the educational work of HCWH, more

than 5,000 medical-waste incinerators have closed since the mid-1990s. In response to the changing regulatory climate, hospital administrators chose to reduce waste and adopt safer waste-disposal and treatment technologies.

In 1998, the American Hospital Association and the EPA entered into a memorandum of understanding to eliminate mercury-containing products from the healthcare sector and reduce waste volumes by 50 percent in ten years. To accomplish these ambitious goals, these organizations joined with the American Nurses Association and HCWH to form Hospitals for a Healthy Environment (H2E). Over the last several years, H2E has grown to include more than 1,206 healthcare partners representing 6,700 healthcare facilities. During this period, virtually all the major pharmacy chains in the country eliminated the sale of mercury thermometers, while major cities and at least ten states have banned their sale as well. At the same time, the nation's largest hospital systems have adopted mercury phase-out policies in their procurement specifications. The largest group purchasing organizations (GPOs)—Premier, Novation, Consorta, Amerinet, Broadlane, and MedAssets—have committed to eliminating mercury-based products from their catalogues. Mercury elimination in the American healthcare sector, although not yet complete, is a powerful success story about how hospitals can collectively use their enormous purchasing power to reduce their environmental and public health footprint and also drive markets for safer alternatives to problematic chemicals and technologies (H2E 2005).

There are additional components to this success story. First, healthcare leaders occupy a highly respected place as trust-holders in American society. If hospitals eliminate mercury from their operations, it creates the political momentum to eliminate mercury from other sectors and other products in our economy, thus improving the safety of the food supply and public health. Since hospitals began moving to remove mercury from their operations in 1998, more than twenty-nine states have passed laws restricting mercury-based products in their states (EIA 2005).

Moreover, since leaders within the American Nurses Association and affiliated organizations learned about mercury, dioxin, and other environmental threats linked to hospital operations, they have become active in more than eight states to support policies to phase out chemicals linked to cancer, birth defects, and genetic damage. In 2005, HCWH launched a website called the Luminary Project (www.theluminaryproject.org) to honor those leaders in the nursing profession who are expanding their understanding of the Hippocratic oath and engaging in preventative medicine through environmental activities in their institutions and in society at large.

Healthcare's path to ecological medicine

Once the link between healthy people and a healthy environment is made, wonderful opportunities present themselves for hospitals that want to model environmental responsibility. A few of these opportunities are discussed below.

Design for health

Over the past twenty years, scores of studies confirm that buildings throughout their life cycles are major contributors to environmental degradation and human illness (Srinivasan, O'Fallon, and Dearry 2003; Portnoy, Flappan, and Barnes 2001). Building-related activities are responsible for 35 percent to 45 percent of carbon dioxide releases into the atmosphere, contributing to global warming and exacerbating stratospheric ozone depletion by using refrigerants and materials such as insulation manufactured with hydrochlorofluorocarbons (HCFCs) (EPA 2006b). Buildings use about 40 percent of raw stone, gravel, sand, and steel; 25 percent of virgin wood; and more than 75 percent of PVC (Roodman 1995, HBN 2006). Buildings also demand about 40 percent of energy assets and 16 percent of water resources, while building construction and demolition generates about 25 percent of municipal solid wastes. Sick building syndrome has been iden-

tified as a frequent contributor to short-term or chronic illness (EPA 2006a). This is consistent with analyses that find that, in the United States, people spend 90 percent of their time indoors and that many common materials emit dangerous compounds and harbor infectious molds, fungi, and bacteria (EPA 1993). For people confined to the indoors due to illness, the consequences are even more severe.

In response, professional associations such as the American Institute of Architects and the World Congress of Architects have issued strongly worded directives advising building professionals to acknowledge sustainable design as basic and fundamental to standard quality practice (AIA 2005). In addition, local, state, and federal public policymakers are adopting green building guidelines and corporations are establishing environmental building standards. These emerging strategies redefine the way buildings ought to be designed, built, and operated. Such policies extend the conventional notion of building performance to include human health and environmental quality as essential cornerstones of quality and value.

Four years ago, the Center for Maximum Potential Building Systems convened a group of leading architects and designers from around the country to develop a green building tool that would be appropriate for the healthcare sector. The result of that project is the *Green Guide for Healthcare* (www.gghc.org). The *Green Guide for Health Care* (GGHC) is modeled on the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standard, but it is goes beyond LEED and includes a more robust framework based on environmental health considerations aligned with healthcare system priorities. Specific guidance on materials selection addresses the chemicals issues raised in this paper. Each recommendation in the guide is accompanied by a summary of its impact on health—either patient health, worker health, or the health of the environment.

In the first eighteen months of its existence, GGHC has attracted enormous interest from the healthcare design community. By June 2006, more than one hundred hospitals around the country, representing more than 40 million square feet of construction, had agreed to pilot the GGHC in their construction projects. Kaiser Permanente, the nation's largest nonprofit health maintenance organization (HMO), has committed to use the GGHC as a framework for its entire system's building plans. During this same period, several building materials and furniture companies that service the healthcare sector have launched new products to capture the rapidly growing interest in healthcare to build "green and healthy." At the policy level, the City of Boston has agreed to recommend the GGHC to the city's hospitals that are engaged in expansion plans.

The healthcare sector's eager acceptance of the GGHC is encouraging. If hospitals help redefine green building to include environmental health as a key component in overall building projects, this could trigger a number of important new directions in healthcare construction and design.

First, it creates the possibility that healthcare can be a leading sector in going beyond first-cost building expenses. If we account for the health and environmental "services" of the building over its entire life, we can save on life-cycle costs in designing the building. This broader way of estimating costs of new construction can help marry construction and operations expenditures in cost calculations and link construction and design teams with operations teams.

Second, if hospitals evaluate buildings along environmental health criteria, it creates the possibility of an entirely new chapter in evidence-based design research in healthcare. The healthcare sector can play a leading role in society in implementing a research agenda that documents how healthy buildings contribute to healthier people and greater productivity. Hospitals can lead society toward building schools, homes, and office buildings that also promote occupant health and consider the environmental and public health implications of the building materials and systems themselves.

Healthy food in healthcare

The dominant industrial food system in the United States is currently a leading factor in a host of preventable health and environmental problems. For example, poor nutrition is a risk factor for four of the six leading causes of death—heart disease, stroke, diabetes, and cancer. Pesticide drift, field runoff, waste burning, and diesel exhaust from transporting food long distances are all factors of food production that contribute to air and water pollution. Additionally, the expansion of large-scale animal feedlot operations has contributed significantly to the demise of independent family farms, contaminating groundwater with nitrates, hormones, and other products of untreated animal waste and creating the conditions for virulent pathogens to spread.

Rather than fresh fruits and vegetables, whole grains, and other high-fiber foods important for health, our current food system favors the production of feedlot-raised animal products and highly refined calorie-dense foods. This is not only a food system misaligned with the US dietary guidelines: it is also a food system that is largely reliant on production and distribution methods that undermine public health and the environment in which we live (Koc and Dahlberg 2004).

As places of healing, hospitals have an incentive to provide food that is healthy for people and the environment in which we live. Yet many healthcare facilities are increasingly trying to save costs by buying inexpensive and pre-processed food. Part of the reason this food is inexpensive has to do with the agricultural subsidies that have brought down the cost of certain commodities, like corn for corn syrup, soybeans for partially hydrogenated oil, and mass-produced grains that are often highly processed before they reach our plates. However, cheap production has come with a very steep price in terms of our environment and nutritional needs (IATP 2006).

For hospitals, it presents a particularly ironic position: How can we expect the larger society to understand the links between good food and human health if our "healing spaces" are filled with products that are part of the problem?

Hospital leaders are beginning to rise to this challenge. Several large healthcare systems have begun to promote better health and responsible farming practices by purchasing fresher, better tasting, and nutritious food for their patients, staff, and broader community. Both Kaiser Permanente and Catholic Healthcare West (CHW) have passed overarching food policies that clearly align their institutions with both healthy food choices for their patients and sustainable agriculture practices.

CHW's policy states: "CHW recognizes that food production and distribution systems have wide ranging impacts on the quality of ecosystems and their communities, and so; CHW recognizes that healthy food is defined not only by nutritional quality, but equally by a food system which is economically viable, environmentally sustainable and which supports human dignity and justice, and so; CHW aspires to develop a healthy food system" (CHW 2006).

From sponsoring farmers markets to adopting better procurement guidelines, hospitals can make a difference. And by supporting food production that is local, humane, and protective of the environment, healthcare providers can lead the way to more sustainable agricultural practices in their communities. These sweeping changes help redefine the term *community benefit* and allow the hospital system to expand its health promotion mission beyond the four walls of its facilities.

In the past two years, Kaiser Permanente has established farmers markets at the majority of its hospital campuses. In some locations, the Kaiser Permanente lobby is the only place to get fresh and organic produce in the community (Kaiser Permanente 2006). Large GPOs, which purchase supplies for 72 percent of the healthcare market, are developing specifications to buy meat without the use of nontherapeutic antibiotics in the production process (KnowledgeSource 2006). This one change alone could help ensure

that essential antibiotic drugs are not rendered ineffective by agricultural overuse of antibiotics (Huffling 2006, Shea 2004). Healthcare's position on this critical issue sends an important message to the marketplace that the overuse of antibiotics for meat production is a problem for healthcare providers in America.

Safer chemical policies

In the introduction to this paper, we discussed how chemicals have invaded every aspect of our lives, including our bodies. These chemicals are linked to a wide variety of preventable diseases, including cancer, birth defects, immune-related diseases, learning disabilities, and asthma (CHE 2006). Clearly, if our society could eliminate these chemical exposures, a great deal of disease could be prevented, thus avoiding the enormous burden on the healthcare system.

In 1994 and again in 2005, the US General Accounting Office reported that the US chemical policy regime does not properly assess or control the public health impacts of chemicals. In the last twenty-seven years, only five chemicals or chemical classes have been restricted due to their impact on public health via the Toxic Substances Control Act, yet thousands of new chemicals have entered the marketplace without comprehensive toxicity testing (Wilson 2006).

"To heal their patients and safeguard the health of their employees, hospital leaders recognize they must also do their part to transform their hospitals to promote healing, while using their purchasing power to heal their community and the planet. "

To address this lack of federal leadership on chemical policy, as well as to address its own contribution to a chemical-dependent economy, healthcare systems have begun to develop their own chemical policies to purchase safer chemicals. This far-reaching framework is a powerful signal to the marketplace that healthcare is planning to use its purchasing power to drive markets for safer products. If manufacturers want to provide products within this new framework, they will need to reform their production processes and replace potentially dangerous chemicals with safer ones.

Kaiser Permanente's chemical policy states the following: "Kaiser Permanente aspires to create an environment for its workers, members, and visitors that is free from the hazards posed by chemicals that are harmful to humans, animals, and the environment. Kaiser Permanente's mission is to provide affordable, high-quality healthcare services to improve the health of our members and the communities we serve. Our concern for the health of our communities extends to the air we breathe and the water we drink" (Kaiser 2005).

Other healthcare systems and GPOs are also adopting chemical policies to guide their overall procurement. Since healthcare accounts for about 15 percent of the US gross domestic product, the impact on the overall economy could be profound (OECD 2004). Acting in unison, the healthcare sector could provide the needed leadership in its purchasing to demonstrate to other sectors that replacing dangerous chemicals with safer ones is not only good for the American economy, but good for the health of the American people.

Moreover, healthcare influentials can assume leadership as spokespeople for broader chemical policy changes in our society. Indeed, this is already occurring. Leaders from Kaiser Permanente, Consorta, the American Nurses Association, and CHW have testified before state legislatures about the need for chemical policy reform. This expanded role for healthcare reflects the growing awareness that healthcare leaders can play a role in transforming not only their own institutions, but also the society at large.

Conclusion

The hospital of the twenty-first century can promote the health of its patients, employees, the general public, and the environment in its design and operations. The hospital can support the local economy through purchasing an array of safe products and technologies and model the kind of environmentally

responsible institutions every community should have. The hospital, in essence, can situate itself in the broader ecology of its community and region and act as a healing force. In the twenty-first century, health-care leaders can understand that it is difficult to have healthy people on a sick planet. To heal their patients and safeguard the health of their employees, hospital leaders recognize they must also do their part to transform their hospitals to promote healing, while using their purchasing power to heal their community and the planet.

Author Biography

Gary Cohen has been working on environmental health issues for more than twenty years. He is a founder and co-executive director of Health Care Without Harm, the international campaign for environmentally responsible healthcare. He is also the executive director of the Environmental Health Fund, which works on domestic and global chemical safety issues. Cohen is a member of the International Advisory Board of the Sambhavna Clinic and Documentation Center in Bhopal, India, which provides free medical care to the survivors of the Union Carbide gas disaster in Bhopal.

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Values-Driven Design and Construction: Enriching Community Benefits through Green Hospitals

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Introduction

For the past decade, the healthcare industry has been engaged in a transformation of design, construction, and operational practices with a goal of reducing environmental impacts. Quietly and without much fanfare, early industry leaders have begun a radical journey toward a new vision of the industry's health mission. Ten years after the founding of Health Care Without Harm and with early adopters having completed their first sustainable buildings, this is a pivotal moment to assess the state of sustainable design and construction in the healthcare industry from a leadership perspective. Why have organizations taken this on? What challenges have they faced? How have they framed the benefits to their communities? What have been the anticipated, and unanticipated, outcomes?

Healthcare leaders and their organizations engaged in sustainable design and construction are doing so largely because it aligns with their humanitarian and stewardship mission and vision. They've been able to harness their community and/or personal attitudes about the environment toward this end and, very often, their concerns about the environment's effect on their patients' health. They are *not primarily* motivated by pristine wilderness and resource conservation for its own sake, but for the sake of their mission to serve and steward resources and health. For them, it's more than saving energy. It's fundamentally connected to health or to a basic human value.

In the paper that follows, we have identified healthcare leaders and allowed those leaders to tell this story in their words. Of the many organizations and teams engaged in sustainable design, we have located a key group of early adopters who are reaching beyond measures that have economic payback and who are achieving community benefit beyond their four walls. And for a disparate set of reasons, they've been able to overcome certain obstacles that could be framed as having to take on and/or embrace an environmentalist agenda and change the status quo. Those who have made it through the process are emerging transformed—both personally and on an organizational level.

Why this topic and approach

Sustainable design is driving both market transformation and organizational change. Each is necessary for the healthcare industry to sustain itself. There are many reasons the industry is overburdened and slow to change, but this paper begins with the notion that the industry is increasingly recognized as an outmoded system that pollutes. In fact, when viewed in this particular light, the system not only pollutes, it potentially participates in creating the very illnesses it is trying to cure.

Sustainability, or *green building*, calls into question the purpose of the healthcare system. Does it treat sickness or promote the conditions of health? Does it create sickness and prevent health? Is it a paradoxical situation that can be resolved and, if so, how? Do healthcare organizations that undertake green building recognize this paradox, and, if so, are they acting on it?

Can an ecological framework assist organizations in redesigning themselves to "rekindle a commitment to healing, hope, optimism, innovation, and creativity" as Hamilton and Orr (2006) describe it? Does a building program—in this case, a *green building* program, have the capacity to more broadly model change?

Organizations such as Health Care Without Harm that focus on operational initiatives to reduce environmental footprint think so. This paper supports the notion that building programs are agents of these—they are the vehicle by which organizations can transform themselves and/or much of the operational complexity that prevents them from changing course.

Not all green buildings are profoundly impacting the healthcare organizations that create them, but many are. Those are the leaders we sought for this paper, and their experiences confirm the power of sustainable design to guide transformation. They say it permeates their organizations. It affects everything that they do. And that the difference in capital costs between conventional and sustainable building practices is, in many instances, equal to the difference in time they have to spend persuading people to go forward with it. They often devote a lot of personal energy and political capital getting and keeping their organizations on board with this and contend that, if sustainable design practice was normalized, they could devote their organization's energy to modeling this change more broadly in ways that would fundamentally affect healthcare, society, and global health.

Leaders recognize the high cost of inaction on matters of the environment—such as climate change and chemical contamination—on the health of our families, neighbors, and communities at hand and globally. By embedding sustainable design in a broader vision of leadership and mission, these projects and organizations are succeeding in delivering the first generation of sustainable healthcare projects.

We term these *Tier 3 organizations,* and for people in policy and philanthropy, these are the healthcare organizations worth investing in to model broader social and societal change.

Part 1: Background

Status of sustainable design in healthcare

Since 2000, the healthcare sector's engagement in sustainable design has moved at an impressive rate. What was ever so slightly registering in the minds of healthcare industry leaders just six years ago has emerged as a hallmark of better buildings, reflecting a commitment to create physical facilities that support improved patient care, staff productivity and well-being, and environmental stewardship—healthcare's triumvirate. The Setting Health Care's Environmental Agenda (SHEA) conference, held in San Francisco in October 2000, marked the starting line for this short history of remarkable accomplishment. As the first gathering of healthcare leaders to explicitly address environmental stewardship, SHEA set out to "inspire ambitious achievements in every healthcare institution" (Brody 2001, page v). Since then, the industry response to Brody's challenge "to transform the healthcare industry into a model of environmental responsibility" has been overwhelming, creating the essential elements of twenty-first century hospital design.

In the years since 2000, a steady progression of practical, nuts-and-bolts green building tools and resources—customized for the healthcare sector and informed by health-driven values—along with inspirational, on-the-ground accomplishments, have coalesced to create a body of knowledge and know-how that has been set in motion.

In 2002, the American Society for Healthcare Engineering (ASHE) published the *Green Healthcare Construction Guidance Statement*, the first sustainable design guidance document emphasizing a health-based approach (ASHE, 2002). The *Green Guide for Health Care,* the healthcare industry's first best-practices, voluntary green building tool, modeled with permission after the U.S. Green Building Council's

Leadership in Energy and Environmental Design (LEED) rating system, was initiated in 2002, followed by periodic updates and the registering of pilot projects to bolster participation (Green Guide, 2004). While emphasizing the importance of integrated design, the *Green Guide* is organized in two sections—construction and operations—to facilitate its use. Using the *Green Guide for Health Care* as a foundational reference document, the *LEED for Healthcare Application Guide* development process began in 2004. With its release anticipated in 2007, *LEED-Healthcare* will represent the first third-party green building certification tool customized for the healthcare sector.

The rapid market uptake of these tools and resources is manifested today in more than 40 million square feet of green healthcare facilities, representing about 180 healthcare projects. These include more than 100 *Green Guide* pilots, six LEED-certified projects, and about eighty LEED-registered projects. By embracing a life-cycle view of human health and environmental stewardship as strategic definers of success, this new generation of healthcare tools—and the buildings they guide—is poised to accelerate the adoption of health-based green building standards in other sectors.

Tiering environmental performance

In a paper presented at CleanMed 2001, Ted Schettler, MD, MPH, identified three tiers of operational environmental performance evolving in hospitals.

- Tier 1: minimum local, state, and national environmental regulatory compliance

- Tier 2: beyond compliance to measures that save money

- Tier 3: informed by the inextricable link between environment and human health and moving beyond both compliance and monetary savings with a long-term plan to reduce environmental footprint

He contended that applying "triple bottom line" approaches to pollution-prevention initiatives—i.e., measuring economic, social, and environmental benefits—would deliver significant benefits for healthcare organizations and the communities they serve (Schettler 2001). Early Tier 3 hospitals supported this notion. Named one of the state's top four recyclers, the University of Michigan Health System described its program's social benefit as an institutionwide initiative that engages everyone (University of Michigan 2005). A 25 percent solid-waste reduction yielded $30,000 in year 2000 annual savings and diverted more than 830 tons of waste from the community landfill.

As building initiatives accelerate, it is clear that we can apply the same system of tiered performance to organizations engaged in sustainable building. Tier 1 organizations will not undertake green building until they are mandated to do so through legislative policy initiatives. They will not make the link, or the organizational leap, between the health of their facility and the patients they serve.

Tier 2 organizations—lacking perhaps leadership, the necessary internal structure to produce change, and/or the necessary decision support mechanisms to help move beyond regulatory compliance—can move no further than to embrace sustainable building strategies that deliver proven economic performance benefits. Where there is no business case, the effort falls short of its potential; that said, these organizations see the value of having a sustainable healthcare facility and grasp its potential community value.

Finally, Tier 3 organizations create leadership vision and harness all available talent in uniting construction and operations together in transforming their organization's approach to the environment—resource use and stewardship. Comprehensively, they move toward a more fully realized and integrated performance level that achieves both patient and environmental health and returns those benefits back to the

building occupants and the community. These organizations recognize that they can't build a green build-ing and still have Styrofoam cups in their cafeteria. They create authentic stories of stewardship that spring from many levels simultaneously.

For the most part, this paper focuses on the experience of Tier 3 leaders and their organizations, based on the belief that these organizations will drive the necessary market transformation and social change. Their success is pivotal to moving the sustainable design and operational agenda in healthcare forward and forming the foundation for the next generation of Tier 3 leaders. While some Tier 3 leaders have used LEED as a green building framework and third-party certification tool, others have not, believing that it falls short of addressing the complex, overlapping design and operational improvement agenda unique to healthcare or not explicitly connecting buildings and human health. It is anticipated that *LEED-Healthcare*, with significant reliance on the healthcare-specific, health-based *Green Guide for Health Care*, will provide an important building and operational improvement tool for these leaders.

A perspective on community benefit

Hospitals and healthcare represent an essential societal function, with a fundamental mission to care for and heal the sick. In many respects, healthcare institutions are held to a higher ethical standard than virtually any other enterprise, as Hyman and Sage (2005) put it: to do good, not merely to do well.

Moreover, the public perception of a hospital's mission and purpose is generally independent of whether it is for-profit or nonprofit. Commenting on the blurred perception of hospitals' legal status, Everson (2005) stated, "We at the IRS are now faced with a healthcare industry in which it is increasingly diffi-cult to differentiate for-profit from nonprofit healthcare providers." While only tax-exempt healthcare institutions are legally obligated to provide and document community benefit, the healthcare sector as a whole is embracing an extended view of community benefit as aligned with its core mission and as a means to create a competitive advantage in an increasingly competitive marketplace.

The term *community benefit*, rooted in an 1891 legal decision, is defined as "charitable activities that benefit the community as a whole" (Everson 2005). For more than thirty years, nonprofit, tax-exempt hos-pitals in the United States have been required to provide community benefits in the public interest, expanding what constitutes community benefit beyond the original definition of providing indigent care. In 1969, the Internal Revenue Service (IRS) established a community benefit standard, later revised in 1983 (Everson 2005): "…the promotion of health…is deemed beneficial to the community as a whole." The standard provides for broad latitude including any activity deemed as promoting health. Many states require nonprofit hospitals to submit annual reports beyond those required by the IRS. In California, for example, nonprofit hospitals are required to prepare a community benefit plan and an annual document describing activities undertaken "to address community needs within its mission and financial capacity and the process by which the hospital developed the plan in consultation with the community" (IOM 2004). Similarly, in New York, since 1990, nonprofit hospitals are required to prepare community-service plans including the hospital's mission statement, publication of assets and liabilities, assessment of com-munity needs and strategies to address them, and solicitation of input from community stakeholders (IOM 2004).

In light of the formidable financial advantages that come with tax-exempt status—most notably, prop-erty-tax exemption[1] (Keehan 2005)—hospitals have been subjected to increased scrutiny as to what con-stitutes community benefit. To this point, in May 2006, the IRS issued questionnaires to more than 500 tax-exempt hospitals and healthcare organizations seeking, in part, details about the organizations' pro-vision of community benefits—services that "…promote health for the benefit for the community" (Pear 2006). The final question in the *Community Practices* section of the questionnaire—Did your hospital have any other programs or activities that promoted health for the benefit of the community?—opens the door

for hospitals to take credit for the multifaceted and measurable community benefits resulting from the implementation of green building practices increasingly playing out in healthcare today.

A study by Schlesinger and Gray (1998) offers a typology of community benefit, highlighting four different, but overlapping, perspectives:

- *Legal/historical* addresses historical responsibilities of nonprofit hospitals.

- *Market failures* addresses the cost and benefits of medical care.

- *Community health* addresses ways to develop evidence-based relationships between medical services and triggers of health problems.

- *Healthy community* addresses ways to strengthen the social institutions that influence health and quality of life in local communities.

Of the four perspectives, the *community health* and *healthy community* ones are intimately connected to green building. Community health is associated with offering preventive services and promoting health in local communities, with the benefit of reducing hospitalizations and demand for emergency services for what are often preventable illnesses. For example, promoting asthma awareness through community education on common building materials that are asthma triggers, as is the case with Children's-Pittsburgh, supports community health.

Healthy community has a broader frame, extending to "support and sustain optimal health and quality of life" (Schlesinger and Gray 1998). Again, drawing from Children's-Pittsburgh, employees are encouraged to consider moving to a neighborhood adjacent to their new facility, with the multiple benefits of neighborhood revitalization, ability to walk or bike to work, and reducing air emissions associated with automobile commuting.

In her May 2005 testimony to the House Committee on Ways and Means, Carol Keehan, chairperson of the Board of Trustees of the Catholic Health Association of the United States, Pensacola, Florida, and board chair of Sacred Heart Health Systems, also in Pensacola, addressed the issue of benchmarks for community benefit (Keehan 2005). Rather than establishing quantitative benchmarks, Keehan recommends assessing community benefit based on "the value we are providing to our communities," which, as she points out, is not always well-measured by numeric benchmarks.

While we find many community benefits of green buildings can be quantified, others are more challenging. Those that can be quantified include a reduction in electrical-energy use and reduced storm-water runoff with an increase in permeable surfacing. Those with a less direct corollary include a measurable increase in health indicators by creating a walkable campus or a shortening in the patient's length of stay with the addition of natural daylight. In such instances, it is difficult to isolate causal variables.

Study methodology

The goal of this study was to identify a group of participants who express an array of sustainable healthcare pursuits. We sought both geographic diversity, as well as project type differentiation in both scale and program. We included acute-care facilities, ambulatory and cancer centers, and children's hospitals that may or may not include women's services. We also sought those who had completed the first third-party-certified sustainable projects (BC Cancer, Boulder, Discovery, The Lacks Center) and heard stories of their unintentional leadership in this realm and the charmed consequences that followed.

Interview subjects also included representatives of the next generation of leaders and a range of completed (Boulder, Discovery), near completed (Dell Children's, San Juan Regional, Dublin Methodist), and early-stage (Palomar, Spaulding) projects. We found it useful to compare and contrast stories within similar project types

(Dell Children's, U-M Mott), while others add intrigue and variety or are noted for a particular position on public health and the environment (Arkansas COPH, BC Cancer).

We conducted one-hour interviews via conference call. Each call was professionally recorded and transcribed by third-party groups; the content from these are presented in Part 2 of this paper. The complete list of participants, their organizations and their projects are identified in the appendix. We've included an alphabetized listing of our interview subjects, by project name. Throughout the report, we have attributed quotes to the organization, followed by the speaker's last name.

The findings are organized into three sections: "Section A: Mission and vision," "Section B: Connection to community," and "Section C: Framing the benefits back to communities." "Mission and vision" looks at motivation, leadership, organizational change management, and the move toward reuniting construction and operation. "Connection to community" explores how these leading organizations key into community values and their exploration of community benefit, whether those benefits accrue to patients, staff, the surrounding neighborhood, or global health. "Framing the benefits back to communities" examines how organizations frame the benefits that derive from the pursuit of sustainable design and construction, whether those are financial or expressed through enhanced community reputation.

Part 2: Dialogue

Section A: Mission and vision

On health care and environmental leadership
Summary Statement 1: As mission-driven organizations, Tier 3 hospitals and healthcare facilities emphasize environmental leadership.

At the onset of the twenty-first century, healthcare leaders are recognizing their environmental leadership as an essential component of a broader commitment to excellence. "It's about what you value. How well do you know what you value? Are you concerned about the environment? Are you willing to reflect those values in what you're building and show that you'll do something about it? Our values are oriented toward a concern for the environment, a concern for people's welfare, and a concern for excellence and quality delivery" (The Lacks Center, McCorkle).

"Most of us have a mission that encompasses improving the health and well-being of the constituents that we serve through excellence in research, teaching, and patient care. We have a further responsibility to give back to the community, and, as leaders in healthcare, sustainable building is one way that we can fulfill that responsibility" (Children's-Pittsburgh, Oxendale).

For some, environmental stewardship is a legacy value well-embedded in the mission and goals of Tier 3 organizational and community culture. "The mission statement of our Trinity Health System has a phrase that says: 'We will steward the resources entrusted to us'" (The Lacks Center, McCorkle).

"One of Providence Health System's core values as a Catholic organization is stewardship, and a key operating principle is mission. And the last Pope had written encyclicals about care for the environment. I was actually able to stand up in front of the leadership team and say, 'Our organization needs to commit to an environmental initiative, because this allows us to connect to our very mission as a Catholic organization'" (Providence, Glass).

For others, environmental leadership, while consistent with a mission of healing, requires cultivating a broader view of mission "It is our responsibility as healthcare providers, but, more importantly, as senior leaders in this industry, to lead our organizations in thinking as broad as we can about our mission" (Children's-Pittsburgh, Oxendale).

"I always start by talking about our mission and vision. And they both encompass, without having to use the word directly, *stewardship*. The mission is to improve the health of those we serve. And the vision is to be the place where people want to work, physicians want to practice, and, most importantly, where people turn to when they need healthcare services. By building a better building, we are clearly going to improve the health of all those we serve—our patients, our families, our staff, and our physicians. Whether they're there as customers or in service to customers" (Dublin Methodist, Herbert).

"We have an obligation to do it. People want us to do it. Green building is essential for good health. And the indoor environment is intrinsic to our whole mission of healing people and allowing them to do that in a better way. So it works to our benefit and the benefit of the larger society as a whole" (Palomar, Covert).

Environmental leadership is galvanized by a belief that transcends short-term thinking. "One of the community members said, 'Don't build what you can afford; build what you really think you need and want. And, the community will figure out a way to fund it.' And, that's exactly what happened" (San Juan Regional, Frary).

Since the SHEA conference in 2000—the first gathering of healthcare industry leaders with an environmental focus—the significance of environmental leadership as fundamental to healthcare's mission and goals has gained prominence, recognition, and momentum. Environmental stewardship has emerged as a defining facet of leadership, excellence, and quality. "As we looked at the children's hospital, we wanted to make a statement about how committed we are to the internal, as well as the external, environment. It was just the right thing to do" (U-M Mott, Kelch).

A commitment to an expanded view of quality that includes environmental stewardship is affirmed by each of the Tier 3 healthcare organizations interviewed for this paper and provides a compelling foundation for why they have embraced green buildings as an expression of organizational excellence. "The most compelling and resonant benefit of green building, other than constructing a building that works, is to promote environmental sustainability and, by doing so, be viewed as a leader in the industry. As a community resource, a hospital has to be taking a lead role in that" (Spaulding, Waterston).

In some instances, leadership motivates healthcare organizations to seek third-party certification for green buildings. "We felt that Austin and the Seton Family of Hospitals could benefit by not only being perceived as, but fulfilling a role as, community leaders" (Dell Children's, Bonar).

With increasing acknowledgement of the linkages between buildings, development patterns, and human health, the hospital building as a manifestation of value becomes more than symbolic of mission. Indeed, the building sets in motion a connection to the experience inside the building and ramifications at the community and global scales. Healthcare leaders are joining the collective voice of leaders in other sectors in recognizing that buildings, through their life cycle, are significant definers of our ecological future. "As an industry sector, healthcare is uniquely positioned because it reaches across all classes, all economic strata, geographically. It's mission-driven and we're in the healing business. And it's a natural, when you're in the business of healing people, that you want to heal the Earth as well" (Providence, Beam).

"A lot of our mission is to approach everything in the context of environmental stewardship, because by identifying and controlling and, ultimately, preventing all these environmental factors that we're exposed to, we can prevent disease, protect our children, and the environment. We know that" (Hackensack-Gabrellian, Imus).

On the built environment and health
Summary Statement 2: As mission-driven organizations, Tier 3 healthcare leaders are making the connections between the built environment and human health and acting on their awareness through the pursuit of sustainable design and construction.

For many, sustainable building is an extension of ongoing interest in the linkages between the built environment and human health. Initial moments of both personal and organizational awareness are expressed as vivid memories. "It brought into focus who and what we have been for thirty years. Twenty-five years ago, we had a national conference on infants at risk, with some of the smartest people in the country. They were talking about heavy metals and lead, air-quality issues and toxins" (Discovery, Dollard).

"Historically, Kaiser has been very cognizant of the connection between environmental issues and patient health. In 1964—a year after *Silent Spring* was published—Rachel Carson was the keynote speaker at a conference sponsored by Kaiser. It was her last public appearance before she died of cancer. At the end of her life, Carson was extremely controversial, and yet, because Kaiser understood the connection between environment and human health, they were willing to recognize and support her ideas" (Kaiser, Cooper).

"Green design lends guidance to aspects of site management and property ownership that are good for the healing environment; a clean jobsite, for example. You might ask how does that affect what's going on? Well, in having a clean jobsite, we're not only looking out for the health of the kids that come into the building that we design, but in having green products, the 500 workers that we have every day on site building this facility aren't exposed. From our perspective, the benefits of green design begin with facilities' design and construction, in preserving the health of our workforce" (Dell Children's, Bell).

For people engaged in cancer care and pediatrics, there is growing recognition that the public understands the link between the built environment and human health; Tier 3 leaders are responding to their constituents' concerns. "We talk about it a lot, and, in the cancer world, it is important. People are so paranoid about cancer. There are so many stories out there—and the focus more and more is on the environment" (BC Cancer, McNeil).

"My husband and I have a working cattle ranch for kids with cancer in New Mexico, where we spend all summer. We built it environmentally friendly and sustainable for health reasons. There are studies that have linked many pesticides and toxins—and the building materials that contain them—to why these kids are sick. Carcinogens and other toxins can lead to cancer and other childhood diseases, so when we built the ranch, we built it with all of that in mind. From the start, we have received most of our children from Hackensack Medical Center. I thought, 'I wonder if hospital environments have considered all these things.' We had to when we built the ranch" (Hackensack-Gabrellian, Imus).

For other Tier 3 organizations, this becomes a way to demonstrate commitment to the Hippocratic oath, "First, do no harm." "*No harm* has true meaning. Not only internally but externally. Building a sustainable building is such a great opportunity to set the tone for your hospital—in your community" (Boulder, Abelkis).

"Once you know that there are toxic chemicals in products you are purchasing and using in your buildings, you have an obligation to do something about it. Kaiser uses the precautionary principle partly to manage risk—in five or ten years, there may be the science to definitively prove that we should have avoided this material—we try to move away from it earlier" (Kaiser, Kouletsis).

On intentional leadership
Summary Statement 3: For the most part, early adopters of sustainable design have been unintentional leaders who engaged in sustainability because they viewed it as fundamentally the right thing to do in their community and for their organization as a whole.

The purpose of Tier 3 organizations is largely human, if not humanitarian, and done in the interest of the best possible outcome for serving the community's needs. With a kind of enlightened pragmatism toward the design and construction process, these organizations have been able to harness their community and/or own personal attitudes about the environment toward this purpose. "I wasn't forced to make it a

headline issue. Now, it's the headline issue! Had I had to justify it early on, I'm not sure if it would have been viewed in the same way. I sympathize with organizations where they really have to try and create the business case; I did not" (Dublin Methodist, Herbert).

A Tier 3 organization's understanding of how the environment affects patient health motivates them to seek action. "What I focused on more was to create a vision for the organization that was clearly inclusive of the evidence and is compelling both inside and outside the organization" (Dublin Methodist, Herbert).

Likewise, Imus was motivated by the connection of the patient's healing environment to the health of the environment as a whole. She approached the hospital with the idea of a nontoxic housekeeping program after considering whether the cancer patients she and her husband receive at their New Mexico ranch through the Tomorrow's Children Fund were exposed to carcinogenic cleaning products at the hospital.

Imus met with Hackensack University Medical Center Chief Executive Officer John Ferguson in his offices one afternoon. "Well, I got into five minutes, maybe, of telling him how important this was and why, and he said, 'Wait a minute, just stop. This makes too much sense, just common sense, and we're going to do it.' Of course, that's what we did. And successfully! In the spring of 2001, a matter of months, we literally revamped the entire campus at Hackensack. Mr. Ferguson had the right vision and saw the potential here. Immediately he thought, 'Well, this is going to be better for our employees, be better for our patients, be better for the staff, be better for our visitors. Why wouldn't we do it?'" (Hackensack, Imus).

In this and similar instances, sustainable design and healthy building operations become the building blocks for a new facility that yields improved health outcomes. These, then, are seen as a means to an end, not an end in itself.

Tier 3 organizations that were early pioneers of sustainable design rarely aspired to create a sustainable facility as a manifestation of their leadership agenda—it was viewed as simply the right thing to do. "When we were doing the clinic building, my friends and colleagues thought it was radically different. I never thought it was any more radically different than how we've run our agency. It really takes an organization with a green vision. I don't think it's possible to think of green as a hip thing to do and then just try to do it. I think the building has to be part of an overall vision. Now that it's built, I have more colleagues that ask: How did you do this? How can we do it also?" (Discovery, Dollard).

"I didn't really know we were a leader at the time. It just made sense. It was an opportunity that was presented to us that we could do something and build a building that was environmentally sustainable. I wasn't aware that this was really leading edge at the time we actually made the decision" (BC Cancer, McNeil).

At the end of the day, there is a simple enlightened pragmatism, or matter-of-factness, about their ability to embrace sustainable design. "The singular belief system that drives the work that I do is the direct link between quality of the environment and the quality of health. It's just that simple. Foothills has had a huge impact internationally and in the U.S. healthcare community. I can't even tell you how many people have toured it" (Boulder, Abelkis).

The next generation of adopters can be identified as aspirational leaders who recognize the capacity of sustainable building to define Tier 3 leadership and transform organizations. They have learned from these groundbreakers and value these new ideas and their organization's ability to push further: "Could we create this new hospital that incorporates all these ideas? Is there one in the United States? The answer was no. We'd like to be one of those destination sites where seeing is believing. We have taken the leap of faith" (Palomar, Covert).

On managing change
Summary Statement 4: Tier 3 organizations see the design process as embodying a bold view of themselves and exhibit a variety of leadership styles to manage the change necessary to realize the vision.

Leaders acknowledge the power of relatively small operational changes to inspire organizational transformation that resonates through the built environment. "No change that one can make is small, especially when it comes to our health or the environment or the impact it'll have on our health immediately. I think we've proven that at Hackensack. This single fundamental change is a huge change and a significant one because it immediately changed the indoor air quality on campus" (Hackensack-Gabrellian, Imus).

"It's really challenging to see if there are things we can do differently. What do we do in terms of pest control, environmental services? What do you do in terms of recycling, and how does that impact your purchasing policies?" (Children's-Pittsburgh, Oxendale).

To achieve high-performance buildings, leaders are challenging their teams, both internal and outside consultants, to think differently. "This is not that complicated. It's really common sense. All we are doing is challenging things that we've been doing for a long time, and why do we do things for a long time? Just because we are used to it" (Hackensack-Gabrellian, Ferguson).

"We wanted to challenge everything about we believed a typical hospital should look like, how it should act, how it should feel. My vision was to challenge the status quo at virtually every corner. And so that's how we came to 'Run until apprehended.' Frankly, it's hard for the designers, who have had the experience of working with owners, who, when the very first innovative idea that surfaces, say, no way. There was some trust building early on in the process between the owner and the designers to establish an environment that allowed good ideas to come forward. I wanted them to suggest everything. (Laughs) And then we'd go backward from the outer limits, where eventually even cost constraints do play a role but..." (Dublin Methodist, Herbert).

Tier 3 organizations have found local and community support for innovation. St. Mary's Health Care (The Lacks Center) introduced the idea of sustainable design to its in-house design group because LEED had already begun to influence industry and impact design construction standards in the Grand Rapids, Michigan, area. "With Peter Wege's involvement, the momentum and the spirit captured us all. He was giving us a tour, along with other Steelcase representatives, of Steelcase's new facility and we began to think, 'These are some of the same kinds of things that we should incorporate into our new building.' He had not reached that point in his gift giving. But we said, 'We think it's important to do because we can see the benefits of it.' Reduced gasoline, convenience for families...We also just sort of loved the challenge" (The Lacks Center, McCorkle).

Palomar exemplifies an organization inspired by the first wave of green building and primed to build on that early commitment. The organization is simultaneously engaged in a number of partnership and team-building activities, including with the Kresge Foundation, Kaiser Permanente, The Center for Health Design, and the *Green Guide for Health Care*. "Our champion teams went hard to work. Dealing with issues of sustainability, the healing environment and, as well, each group was charged to look at all the various aspects of our designs against finance, quality of the workplace, and making it better for our employees in general" (Palomar, Covert).

And for others, sustainable design taps into a germane set of cultural values that can be acted upon with the right decision supports in place. "It was at the *Boston Design for Health Summit* that it all came together. As a product of the 60s and 70s, I was very concerned with the environment while growing up in the Midwest. When I went to this Design Summit and started hearing what other hospitals across the country had done, or were contemplating, it seemed to me that we ought to put ourselves on a path to do likewise" (Spaulding, Waterston).

As the transformation occurs, Tier 3 organizations recognize their role in raising the bar for the larger industry. Within systems, demonstration projects resonate through the larger system. "The work we are doing is having an impact in the system, and it's generally very well-received. With that comes the creak of the raising of the bar—it clearly is the sound we are hearing" (Dublin Methodist, Herbert).

Finally, these leaders acknowledge that the fear of change is not a reasonable excuse *not* to act. "People who are going through this process are realizing that change and the issues and pressures it brings with it are one thing. But to act on the fear of doing something different by doing nothing would be quite another problem. A lot of this is about stepping outside of the comfort zone... that's what the journey involves" (Dublin, Herbert).

"Being a change agent requires a thick skin and a conviction that what you're doing has value to your organization. And, eventually, what you start to see is hearts and minds changing" (Providence, Beam).

On bridging design and operations
Summary Statement 5: Environmental leadership among Tier 3 facilities is demonstrated through a mission-driven design process that integrates construction and operations in the service of continuous environmental improvement.

Tier 3 organizations consider the operational issues that define their environmental footprint and community messaging in the context of sustainable design and construction undertakings. "Our coffee shop that's in the building refuses to use Styrofoam cups or containers. That's one of the decisions we made early on, even though it doesn't have anything to do with LEED. We all know that Styrofoam is not exactly an environmentally friendly material. So they're using alternatives, which, in fact cost five or ten times as much" (The Lacks Center, Benz).

Furthermore, Tier 3 leaders understand that their communities require authenticity and honesty in approaching matters of environmental responsibility. "It's about having the organization embrace the green hospital from a cultural and mission perspective. One of the fears I had was that we would decide that we were going to be green, have everybody work to get all the points, and then forget about it when the construction was over. Instead, we opted for a comprehensive approach—it's a transformational process to have our staff thinking about everything that they're doing as it relates to the environmental impact. And challenging to see if there are things that we can do differently" (Children's-Pittsburgh, Oxendale).

Environmental awareness, once created, informs all the different aspects of community relations and leads to a culture of continuous improvement. In Tier 3 organizations, green committees, including representatives of design, construction, and operational departments, are spearheading initiatives to reduce environmental footprint. Organizations rely upon, and empower, these groups to challenge the status quo and raise the standard.

Kaiser Permanente has an active High Performance Building Committee that reviews sustainable design and operational initiatives. "Once the stakeholders—members, labor unions, caregivers—are educated about what's going on, the demand increases internally to drive improvement. They're the ones who will generate more demand internally. It's a long journey—it's a huge company—145,000 employees" (Kaiser, Kouletsis).

Geoffrey Glass, director for facility and technology services at Providence St. Peter, launched a group called Stewards for a Sustainable Environment. "We borrowed on the idea of H2E [Hospitals for a Healthy Environment], and call it S2E. That's been this interdisciplinary team of people, four of whom went to CleanMed. After that conference, we developed a listing of everything we wanted to achieve. We meet monthly at 7 a.m., and we're all early. Amidst the rest of the work that we have to do in our jobs, we find time to chase down a number of initiatives simply because of our own passions for them!"

Often, operational improvement programs are implemented while capital projects are in design to ensure that improved operations are in place prior to move-in. For example, while Spaulding is only in the design-development phase, its Green Committee is actively engaging the hospital community through the monthly online newsletter that includes a column on "Greening the Hospital" and features articles on topics ranging from operational improvements to the debate on operable windows. Similarly, Children's-Pittsburgh has been engaged in operational change initiatives for at least two years in anticipation of the opening of its sustainable building in 2008.

In organizations that can synthesize design and operational issues, operational improvements often lead to substantive changes in design and construction practices. Nowhere is this more evident than with Kaiser, which has researched material performance, purchasing contracts, and operational improvement in a comprehensive, coordinated manner.

"We started with a campaign to reduce the amount of material we were sending to landfill from Kaiser construction projects. As we learned more about carpet through the three companies we had national purchasing contracts with, we began to understand that there were a lot more environmental issues associated with carpet manufacture and emissions—indoor air quality. The indoor air-quality issues were connected to maintenance, the kinds of chemicals we were using. We asked tough questions: Is carpet a filter or a sponge, is carpet worse or better for the environment? We started looking more at the fibers as we talked to manufacturers about recycled content, what kind of backing they were using, and we used outside consultants to educate us beyond the waste issues associated with those materials. We now specify and purchase carpet differently" (Kaiser, Cooper).

Once the buildings are in place, their existence inspires continued environmental improvement. "I now have a director of environmental policy. We're now putting out policy positions to bidders or contractors that won't allow them to use certain materials. We don't even have to talk about it anymore—we just implement it. I think the building has been this remarkable metaphor for us to say: We can do this...and more!" (Discovery, Dollard).

For many Tier 3 organizations, sustainable design has the capacity to positively impact the facility design process through policy enactment; creation of standards programs; or research, measurement, and verification activities. Within systems, the projects are universally seen as models for future system capital project initiatives. "There was an epiphany around our Newberg project. It's fair to say that hearts and minds were changed within our organization about ecocharrettes and about building sustainability and energy efficiency into our facilities. And it was the genesis of what now has become a standard throughout Providence. We have a system here now that requires that an ecocharrette be conducted for every construction project over $5 million. It's now embedded in how we do our business of construction" (Providence, Beam).

"I don't think the goal of LEED certification has substantially altered our processes about inclusiveness of the design, but it has brought more people into the process and opened some minds to this in a very positive way" (U-M Mott, Kelch).

"Foothills has set the standard. We basically threw out our maintenance book when we opened our LEED-certified facility and adopted those new standards—everything else went out the window. Whenever we're looking at upgrading something, we will look to the Foothills as our common denominator" (Boulder, Abelkis).

On market transformation
Summary Statement 6: Tier 3 organizations recognize the power of the industry to transform markets through purchasing initiatives and wise use of resources.

U-M Mott looked for demonstration opportunities to test and eventually grow the university's basic building standards by selecting environmentally preferred materials. These would be used for cosmetic upgrades at existing facilities and in successive new facilities that fell under the planned new major buildings program. "In our planning we already were looking for product substitutes. We had put down rubber flooring in our current hospital in one of the floors because we wanted to test its durability and see whether the staff felt a difference. That's an example of something we started before even registering our project with LEED" (U-M Mott, Warner).

This seeing-is-believing approach accrues other benefits as well. Manufacturers are incentivized at a much larger scale. They can respond easily to the communitywide expectation for their products and are encouraged to see new markets taking hold. Likewise, the design team is freed of many obstacles when the client gets involved.

"We need to really shake up, not only the architecture and design community, but also the manufacturers, because while they're taking the steps, they're baby steps. It's like the automotive industry: the technology is there. We used cotton denim insulation as an example. There were no LEED points for it because we had to drive it across the country from Colorado and Arizona, but then when we thought about it, why would we want fiberglass, and fiberglass sitting in those walls for years and years and years?" (Hackensack-Gabrellian, Heeley).

"Unless you have a major purchaser or market for a product, I'm not certain that even architect/specifiers can push it—it's really incumbent upon the owners—in this case, the healthcare industry—to demand these products. Kaiser, as a major voice for this industry, has taken a stand. Until we did, all of our visionary architects, interior designers, and supplier reps couldn't get the attention of the manufacturing industry" (Kaiser, Kouletsis).

Often, Tier 3 leaders express frustration at the limited sustainable material choices in the marketplace. They long for innovative products that meet the performance needs of healthcare settings and transparent material evaluation protocols to ensure environmental benefit.

"I often wish that there were magic bullets that would allow us to make clear tradeoff decisions quickly —is the chemical pack in the waterless urinal worse for the environment than using the water to flush a conventional fixture? These are the kind of tradeoff decisions we are asked to make daily around these issues, and the data are just not forthcoming or simple. A lot of times the choices are not great—either the products don't exist or they are so costly that they are not economically viable. One of my frustrations is that we are often forced to make the best of a range of poor choices" (Kaiser, Kouletsis).

They comment on the need to create industry demand for better, healthier materials—most have stories of battling the market for environmentally preferable options. Only with increased demand will the initial first-cost premiums for innovative materials be reduced or eliminated.

"We decided we'd try other than PVC (vinyl) materials. We went back through our materials palette and tried the rubber flooring experiment. That experiment failed. But we had migrated down the path of having decided, 'Yes, we want to be green in our choice of materials. Now, let's go out and learn what works and what doesn't.' And now we are saying, 'If we're going to have a resilient floor, it's going to be an eco-polymer, even if it's going to cause us to choke a little on the initial cost. We realize that we can service this economically and get a sustainable eco-polymer floor'" (Providence, Glass).

An appeal to commonsense knowledge of what patients would like and appreciate at hospitals and would positively affect their experiences as well as their health outcomes is causing officials in some instances to relax regulatory constraints and allow innovation to occur. "The Department of Public Health says you need, say, X-amount of foot candles for the doctor to examine the patient. But a green consultant might

say that a patient room should be able to get by with half that much. In negotiating with the DPH to separate the lighting circuits in the patient room into three separate circuits, we have a general room light, which is a couple of downlights that are dimmable and that are decorative, we have a reading light over the bed for the patient, and we have standard 2x4 fluorescent lights for the examination" (The Lacks Center, McCorkle).

Section B: Connection to community

Connection to community values
Summary Statement 7: Tier 3 healthcare leaders view their buildings as manifesting the values embedded in the communities they serve; within environmentally progressive communities, the healthcare sector's environmental leadership is essential.

Organizations in environmentally progressive communities are compelled to demonstrate environmental leadership or lose their community connectivity. Many of the early adopters are community hospitals—organizations with close local ties—located in environmentally progressive regions or in cities with a public commitment to sustainable development. The Pacific Northwest and northern Michigan are regions described as having strong support for environmental improvement. "We're blessed in Olympia to have a very progressive environmental community. People move here for the environment, sitting where we do in South Puget Sound, at the gateway to the Olympia River and the Cascade Mountains. Lots of folks enjoy the outdoors" (Providence, Beam).

Community environmental awareness is rapidly increasing; early adopters noted that standing with or being ahead of the community awareness level is key to maintaining market leadership. "We're seeing a huge shift in awareness out in the general public about our impacts—both the hospital's and their own. The City of Boulder is renowned for the idea of environmental stewardship. We're trying to reflect a sense of community through what we value. You define values as a community. And to me, this community represents the values of people who live here. I'm a firm believer that, in life, you are the choices that you make" (Boulder, Abelkis).

Pittsburgh, Pennsylvania; Vancouver, British Columbia; Boston, Massachusetts; Boulder, Colorado; Grand Rapids, Michigan; Little Rock, Arkansas; and Austin, Texas—all have progressive, successful local green building initiatives that provided both context and local support for healthcare sector green building initiatives:

"One of the things that's interesting about the Grand Rapids area is that it has a larger-than-normal number of green buildings. If you go to the U.S. Green Building Council's site and look up Michigan, you'll find a huge concentration of green buildings in this area. It's part of our heritage. It stems from the forest industry and from living off the land in Michigan. It's also tied to the psyche of the Grand Rapids population. As a result, we receive a lot of community support" (The Lacks Center, Benz).

In progressive communities, organizations that engage in sustainable building initiatives align themselves with leading peers in other private industries approaching sustainable building. "What's happened since in the community has been astonishing; we have several LEED-certified buildings in Little Rock. When our staff see the success of the Heifer Project, the Clinton Library, and so forth, they say, 'Yeah, we want that too'" (Arkansas COPH, Gehring).

In regions where sustainable building is under way, healthcare is redefined as a civic function and a pivotal community economic partner. As nonprofits, healthcare organizations are using their environmental leadership to maintain and enhance community support for programs, services, development, and expansion in the service of promoting health for the benefit of the community. "By charting the responsible path and replacing facilities within the construct of the City of Austin's goals for a cleaner environment, we could add to our public image in the community" (Dell Children's, Bonar).

"As we got closer to building the College of Public Health, it was all about, How do we do this as a demonstration project for what's good for the community? What's good for the nation? What's good for our environment? All those questions" (Arkansas COPH, Gehring).

"We think that a sustainable, high-efficiency building makes a statement to our community about our commitment to them to provide the very best healthcare, in a healing environment that they will all benefit from" (Providence, Beam).

"We look at how we can serve our community. This LEED facility is just one more aspect of our hospital, as a community hospital, people feel connected to. People contribute, donate, volunteer, and that's the reason why we can go forward. Our environmental stewardship is again just another natural extension of our community values" (Boulder, Abelkis).

Community connectivity and presence

Summary Statement 8: Tier 3 healthcare organizations, through sustainable siting, design, and construction, become visible advocates for Smart Growth initiatives, sustainable development patterns, site restoration, healthy-lifestyle options, and community revitalization.

Sustainable design initiatives provide a mechanism to engage in and be recognized for supporting community economic revitalization and healthier lifestyles. Initiatives range from encouragement of staff to purchase neighborhood housing (Children's-Pittsburgh) to hosting farmers markets on site (Kaiser). As a first step in aligning values, Tier 3 projects have consciously chosen urban and semi-urban sites (Children's-Pittsburgh, Dell Children's, Boulder, BC Cancer, Dublin Methodist, Palomar, Spaulding) over exurban and suburban locations to avoid greenfield development and/or to reduce transportation burdens. In nearly all other instances, a site was carefully chosen on an existing campus.

Pittsburgh opted to rehabilitate a vacant downtown hospital campus rather than to develop a greenfield site in a suburban location, citing concerns about loss of community connectivity. They are now working with their Community Development Corp. on incentive programs for staff to purchase housing in the immediate Lawrenceville area. For Palomar, creating solutions to address the affordable housing challenges confronting staff in the immediate area of the Palomar replacement hospital site are viewed as a priority: "Now we're talking about how to create housing opportunities for our staff and for others" (Palomar, Covert).

Where projects are located in less densely populated areas, or where mass transit is already widely in use, Tier 3 leaders seek creative solutions to mitigate reliance on automobiles. They become vocal, active advocates in support of public transportation systems. "We will have to work with the city on public transportation. I would say over 60 percent of our staff and patients come by public transportation. Right now, the Navy Yard is not a very densely populated area, so buses don't run frequently enough for our staff. Given our site and the budget, we know we can't build more than 300 parking spaces" (Spaulding, Waterston).

In urban areas well-served by public transportation networks, organizations are successful at reducing the required on-site parking. "The City of Vancouver waived the parking requirement because we had a good argument, based on the idea that most of the people in the building do not use their cars. They're post docs; they take the bus. We wanted to encourage bus use. So did they" (BC Cancer, McNeil).

Even in areas with limited options for public transportation, Tier 3 leaders think creatively about alternatives to private auto use. "We are expanding van pools and are in discussions with North County Transit Authority about connecting with the Sprinter (a light-rail system). Part of solving the transportation problem is through the creation of a mixed-use site—we see an opportunity for assisted-living capacity and other commercial business opportunities" (Palomar, Covert).

In some instances, Tier 3 leaders move toward consolidating services as a strategy for reducing transportation burdens for staff and patients. "Before the creation of The Lacks Cancer Center, cancer patients and their families needed two things: they needed reliable transportation and they needed a good map—a road map—because they were going twenty-six places. This was the idea behind The Lacks Cancer Center, that all of these services, the complete continuum of care, could be provided right here in this one extraordinary facility" (The Lacks Center, McCorkle).

In completed green projects, alternative transportation use often exceeds projected demand, further demonstrating that a strongly articulated environmental stewardship mission resonates with building users. "I do believe that, for a number of our employees, that idea of green building and living in a sustainable world is now a reality for them. It comes to mind regarding bicycles. I've had to put two or three more bike racks out at Foothills. It keeps expanding because more and more people are bicycling. We're connected to a terrific bike path that literally almost directly connects to our Broadway facility. Some doctors who ride their bikes can get from here to there in 15 minutes" (Boulder, Abelkis).

Sustainable design programs reward healthcare organizations for remediating environmentally damaged properties and restoring damaged ecosystems. Dell Children's, for example, revisited an initial decision to move to a suburban greenfield site and instead opted for a more central brownfield site in the city's desired development zone. "We took it as an opportunity to be particularly careful about what kind of development example we set, and the city encouraged us to set a high bar for the construction that would come after us in the development of the site" (Dell Children's, Bonar).

Likewise, Spaulding is remediating a brownfield site in the long-abandoned Boston Navy Yard. The City of Boulder encouraged Boulder Community Hospital to take on an environmentally damaged site in the hope of achieving its restoration. "Much of the site was wetlands—it had been really destroyed by cattle grazing. And so we created additional wetlands. A portion of the land is just not touched anymore; it's going back to its natural state of being—We will never develop it, nor do we want to" (Boulder, Abelkis).

This concept of stewardship leads us to a final group of Tier 3 leaders who actively advocate for protecting valuable natural sites and habitat for their communities. "When people arrive at Providence St. Peter, the entire building campus is shrouded in a forest of trees. Of our 154 acres, only about 60 acres are developed as the building site, and the balance of it is second-growth forestland—150-foot trees. We border a class I salmon wetlands. We own it. And probably 40 percent of our property is undevelopable. There's this little creature called an Olympic mud minnow we protect—we hear that half the world's population lives in this creek that borders our hospital. We regard our site as a precious resource—our community agrees with that" (Providence, Glass).

As Tier 3 organizations engage in green building, they become more empowered, visible, and active participants in wider community sustainability initiatives.

"Our local community college has now put together an energy park. And we're there with them trying to recruit energy companies, wind, solar, geothermal interests, to set up in the energy park at the college and start to have students get more involved in green stuff. We are the largest employer in our county, and we do a lot of construction. We've been asked to set up a laboratory there that would help train plumbers and electricians and other trades people to know how to install and better understand this green technology or sustainable technology. That could have remarkable payoff for us. So we're trying to better educate contractors in our region. It's a very practical step" (Discovery, Dollard).

Connecting to community and its behaviors
Summary Statement 9: Tier 3 organizations see the opportunity to model behaviors about healthier living and, conversely, model themselves after community needs and values.

Hospitals engaged in sustainable building have the opportunity to create meaningful examples that are tangible demonstrations of doing the right thing for environmental and human health. For Kaiser, sustainable building is directly linked to its marketing and education campaign focused around healthier lifestyles: "We have the Thrive campaign, which is looking at people's health and lifestyle. Our marketing folks are very interested in the sustainability program because it fits in perfectly with Kaisers' 'interest in improving your health and your lifestyle.' By building smarter, better buildings that have fewer harmful impacts on the communities we serve, we're promoting that same view that the campaign is projecting to potential members" (Kaiser, Cooper).

San Juan Regional removed a publicly visible facility that had unintentionally become a smoker's hangout, held smoking-cessation classes, and is implementing a campuswide nonsmoking program, benefiting patient and community health. In this instance, the healthcare provider is able to effectively implement programs and policies from the top down in an effort to protect and advocate for health needs. Interestingly, San Juan Regional is also able to take from the community a healthy behavior that it then models back into the patients' healing environment. Farmington, New Mexico, has a large Native American population with a need for gathering spaces large enough to accommodate families' practices, social customs, and healing rituals. After receiving community input, a meditation room was provided on each floor.

Many Tier 3 leaders are using sustainable building and operation to catalyze larger organizational transformation in the service of the patient experience. In the landmark book, *The Experience Economy*, co-authors Joseph Pine and James Gilmore contend that people seek transformation in their healthcare encounter and that they look to hospitals in part to guide this transformation. "Patients don't want to feel less sick, they want to be well" (Pine and Gilmore 2004).

Hospital patients and their families are looking for an environment that supports a transformational experience, and sustainable building is viewed as having the capacity to catalyze this change. "Another major theme that emerged in our design process was that of transformation, whether it was from a patient's standpoint coming in ill and leaving well or from an employee's standpoint coming in saying, 'This day I want to be able to have a significant impact on the care of this organization and an impact on people's lives'" (Children's-Pittsburgh, Oxendale).

Many view the healing process as a teachable moment in the lives of patients and staff. The building and its operation can positively create healthy experiences that trigger behavioral changes.

"One of the interesting aspects of a sustainable healthcare facility is the number of people who come in and out of the doors. And where they are in their lives at the moment that you have them. You have people in an educable moment and, that is, I think, a really compelling argument. You have so many staff, and so many patients, and the patients are there because they're vulnerable. And they've just gone through some potentially life-and-death situation and are coming out on the side of life, but are at a moment to think about quality of life" (Spaulding, Waterston).

Tier 3 providers are major employers in communities and regions and have the potential to reach and influence large numbers of people in their communities with sustainable building initiatives. "Hospitals are such an integral part of every community. We're the largest health system in Alaska, Washington, and Oregon. And so when we have this philosophy, it tends to have an impact that is disproportionate because of how close we are to our communities" (Providence, Koster).

In many instances, this is about allowing people to live their environmental values while in the building. "We allow people to reflect their community values by recycling, taking their bike to work, the bus to work, using products that are more environmentally sound, whatever. A majority say this is what they believe in and this is how they want to live—they're very proud of that and they tell me that themselves" (Boulder, Abelkis).

On building community within

Summary Statement 10: Tier 3 organizations recognize that medical spaces and technologies are in the service of humans and that a broader vision of health and wellness is a program imperative—not a program addition. This broader focus of creating community, healing environments, and experience inherently requires consideration of both evidence-based design and sustainable measures.

Some Tier 3 organizations take a largely sustainable approach, while others focus on an evidence-based design approach—in fact, most are drawing from both. For all intents, one does not happen without consideration of the other since each encompasses a broad vision of occupant health and personal well-being as essential components of a twenty-first century better building.

San Juan Regional, which is neither formally engaged in evidence-based design nor sustainable-design processes, drew heavily on both in the design of its new bed tower. For example, it engaged almost 10 percent of its staff in the design process. It conducted multiple open houses with the community and three charrettes—one on sustainability, one on patient-room design, and one on healing-garden design. As a result, it included meditation rooms on each floor (see Summary Statement 9) and developed a building that stressed connection to the outdoors (see Summary Statement 13). It also included child-care amenities for staff. "As we designed the tower, we also kept in mind that need, or want, to personalize the experience for not only the patient, but also for the employee" (San Juan Regional, Frary).

This primary focus on people throughout both processes is what differentiates twenty-first century design approaches from those of the past. "Remember you are putting people in this building—remember who you are really serving. We always worry about whether we get everything we need for an X-ray unit. What if we just get the things we need for the humans who are going to work and live in this building for the point in time beyond our own?" (Arkansas COPH, Gehring).

As such, Tier 3 organizations today recognize that medical spaces and technologies are in the service of humans, not the other way around. For example, at BC Cancer, architects were charged with stirring interaction among the researchers, and, subsequently, designed a central, open stair. Initially seen as controversial program move, the communicating staircase is now a focal point for the building community. "We are building a bridge that reaches bench to bedside. ... We didn't want them to go to the lab, stay there all day, and then leave. ... We wanted to encourage them to use the staircase and not the elevators as much, but you don't do that by putting the staircase in the middle of the building in the dark. People do use it, but it's much better if the staircase is attractive" (BC Cancer, McNeil).

"Today, medical centers talk about a tripartite mission, where your focus is not only on your patient care/operations but also your teaching and your research" (Children's-Pittsburgh, Oxendale).

For many projects, this requires defining nontraditional spaces that create community within the buildings and on the grounds: "We visualized a meeting space that we called the Bruce Commons for Arkansans to come together on health issues. It's named for one of the people deeply involved in the process, Dr. Bruce. We wanted to do this in a way that illustrated all those facets of health prevention and early treatment, so we included the open stair to encourage walking and interaction" (Arkansas COPH, Gehring).

In fact, it is unlikely that a Tier 3 organization will embrace the concept of patient-centered and family-centered care and not also embrace a connection to nature, the patient experience, healing, and the healing environment in its design approach. "One of the lenses we look through is around being environmentally conscious. We also ask ourselves if this is this going to be a healthcare facility that will last through the changes of healthcare over the next twenty years. And if so, does the business model make sense within the context of the demographics of the market ... Hospitals are big, huge investments. So when we have the opportunity to build one, we have to be able to build something that can really express what we stand for" (Providence, Koster).

"In our conversations we focused on the human aspects of LEED certification. We did not talk very much about what the advantages are of having the co-generation plant. While meaningful to us, it wouldn't mean much to the brain surgeons" (Dell Children's, Bonar).

And last, in embracing a comprehensive sustainable design approach, unexpected outcomes occur. "Interestingly enough, green design lends guidance to aspects of site management and property owner-ship that are good for the healing environment as well. ... It's even likely we'll have a struggle on our hands when this hospital opens. Nurses and recruits who've been in small hospitals with no access to daylight will easily say, 'You know, I'd really like to go work at Children's'" (Dell Children's, Bell).

"What we are finally doing is putting the client in the center of the process instead of the technology. I think the College of Public Health started that process" (Arkansas COPH, Gehring).

On medicine and public health
Summary Statement 11: As a shift in medicine and medical education continues to occur, a new generation of medical professionals, with interest in the environment and health, are beginning to reintegrate the dis-ciplines of medicine and public health. Increasingly, Tier 3 healthcare organizations are taking on a visible advocacy role with regard to public and community health.

An ecological framework for construction and operations brings with it not simply a concern for impacts of the built environment on the local community and its resource base, but also a greater emphasis on community health. "Our responsibility as a pediatric healthcare organization is not just to care about the kids that come into our organization, but to care about all the kids in the community and what impacts their lives. ... There is a larger imperative for healthcare systems to advocate for the broader public on public-health and community-health issues. I don't think it's widely acknowledged, but it's important for us as leaders in the community" (Children's-Pittsburgh, Oxendale).

In this instance, a larger academic medical center brings forward a connection between sustainable design, operations, and the provision of medical services in a systemwide approach to improve commu-nity health. "Every one of our patients depends on us to advocate on their behalf. They cannot advocate for themselves because they're children," (Dell Children's, Bonar). In both instances, these Tier 3 leaders are advocating a community health agenda that ripples through their respective systems (University of Pittsburgh Medical Center and Seton Healthcare Family of Hospitals, respectively).

Leaders in environmental medicine and public health are impacting decisions to pursue sustainable design and operational initiatives in healthcare organizations. In academic medical centers, these questions are prompting healthcare organizations to navigate the reconvergence of public health, medicine, and envi-ronmental health to "accomplish the synergies that we need to within the broader organization" (Children's-Pittsburgh, Oxendale).

Some see it as fundamental to a physician's value system:

"In healthcare, sustainable building represents a fairly bold move toward precaution and prevention. The building stands for health. In creating it, the organization is essentially saying, 'We're investing in keep-ing people healthier.' And that is a difference in the way that the United States has approached health-care. But it's consistent with a physician's value system. It represents a mindset and a culture of health as opposed to sickness treatment. Healing is something that is so intangible. Creating the right environ-ment for people mentally, physically, spiritually is so important. Really being attentive to sustainability and wellness and developing a holistic view of healthcare has an impact that we may not be able to meas-ure or test, but I'm convinced it has a tremendous impact on somebody's ability to attain health. Not just to be not sick, but to be in health" (Providence, Koster).

Likewise, sustainable design and construction is energizing medical education. "Our residents and faculty members are very interested in the fact that we're building a green hospital, and they're enthused about the kinds of research questions that might be asked and the implications for the resident-training process" (Children's-Pittsburgh, Oxendale).

"Many of the students going through medical school are getting master's degrees in public health along with their doctorate in medicine. It used to be that they'd get it in biochemistry or research of some kind. Now they're looking into public health" (Arkansas COPH, Gehring).

In academic settings, medical students are becoming champions for sustainable design and operational initiatives. "There is a lot of interest amongst our medical students and other students. They're very, very bright; they're influential; they're persuasive. They may not be fully informed about all of the economics of healthcare, but they are very well-informed about environment and sustainable design. They brought a lot of information to the table" (U-M Mott, Kelch).

"Our second- and third-year residents heard that we were doing a sustainable building and asked to meet with me. They planned six different lunch-and-learn sessions around environmental impact on healthcare for this year. They initiated it on their own" (Children's-Pittsburgh, Oxendale).

On an urgency to act
Summary Statement 12: As sustainable buildings explicitly message health, organizations recognize a massive culture change toward a broader, long-term view of mission and more proactive stance on global health and resource stewardship.

Healthcare infrastructure and operations have both enormous impact on and responsibility to oversee change. "People in general are reluctant to embrace change. At some point in time, the idea is so pervasive it becomes the common wisdom. Being an environmentalist no longer is seen as radical—it's just a component of being a responsible citizen. Global warming, recent unfortunate weather events—[hurricanes] Rita and Katrina—people are beginning to connect the dots. Some of the reaction is fear, but the majority of people is jumping on and saying it's the right thing to do" (Kaiser, Kouletsis).

"I certainly sense it in our organization, that there's a grassroots effort at Providence. It's bubbling up all over the place. We're starting to see programs emerge all around the Providence health system. ... And people are sensing that these resources that we all hold in trust for future generations, that we need to do something positive, to save the world from ourselves, I guess" (Providence, Beam).

Beam recalls a meeting with Janine Benyus, author of *Biomimicry: Innovations Inspired by Nature*. "I met with her at an inland Northwest sustainability conference in Boise, Idaho, last year, and I asked her to inscribe something in my copy of her book about her work and how her work and mine really meshed in some way. She wrote: 'Providence Health and Services has two patients, the medical patient and the earth. To heal one without the other will not last.' It's true for healthcare. We have to do both" (Providence, Beam).

As an energy- and water-intensive sector, Tier 3 leaders grapple with the imperative to manage resources wisely and effectively. Sustainable design offers a way to more effectively quantify and manage energy and water use and communicate those improvements to the communities impacted by their operation. "When the architects were out here for their first few visits there was no water in the river. In terms of the environment, we knew we had multiple stressors. We knew that we needed to be very good neighbors when it came to water, so all of the landscaping features are designed for low water use" (San Juan Regional, Frary).

Across the country, early adopters recognize both the high cost of energy and the wider impact of fossil-fuel use on community health. "There's a diabolical thing that's hanging over all of us, if you pay attention. Energy itself is only going to get more expensive, and more complex to manage. For the long-term,

particularly in the Northeast, it's important to have control and a handle on what your energy source is going to be. Everybody has to move away from oil. It's critical" (Discovery, Dollard).

"Our health system operates in weather zones from Southern California to Alaska. It's interesting to note how different utilities view the environmental impacts of global warming and what they're trying to do about it in their communities. In the Northwest, particularly, there is this great sense that it's the right thing to do make energy efficiency or energy conservation part of a utility company's least-cost plan to provide electricity, both now and in the future, to their community" (Providence, Beam).

"The local newspaper environmental reporter and I are regularly in communication because John writes a weekly one-page paper that's dedicated to the environment. A couple years ago, when energy costs accelerated wildly, we were one of the first ones that John called. 'What have you done to save energy?' Of all the things I've done that have connected with our senior administration, it's been that behind-the-scenes, positive recognition to our community for something that is important to them" (Providence, Glass).

As the science converges on the intersection between chemicals and human health, leaders are challenging themselves to take a broader view and more proactive stance on global human health. Clearly, Tier 3 children's hospital chief executive officers and their spokespeople view the science as important to their constituents and communities. "People look at children's hospitals and expect them to be leaders in areas like this" (Dell Children's, Bonar).

"We approach everything from an environmental perspective because by identifying, controlling, and, ultimately, preventing all these environmental exposures, we can prevent disease. We know that. We can protect our children, the environment, and ourselves. It is the whole global picture" (Hackensack-Gabrellian, Imus).

"There are many, many examples where the environment has affected and can affect children in negative ways. Look at lead poisoning—leaded gasoline in the past; today lead paint is still doing damage. And when you damage the developing brain, it's often permanent. We're learning more and more that children are precious when they're developing, and they're more susceptible for all sorts of insults—including environmental insults. So as a pediatrician, I feel that we need to construct the best environment possible in the hospital" (U-M Mott, Kelch).

Finally, these Tier 3 leaders agree that reducing the sector's environmental impacts requires a long-term view of mission, responsibility, and resource use. "Try to take a very, very long term view...Sometimes we find ourselves forced to develop a shorter term fix-it-now-as-fast-as-you-can plan. And those usually are not the best plans. That has helped me think through situations and allowed me to say, 'We really need to do this because it's the right thing for the long term'" (U-M Mott, Kelch).

This requires commitments that extend for years. "In order to keep sustainability from becoming the flavor of the month, you have to have a commitment to the resources to keep an ongoing focus. As we have all discovered, even a simple issue requires research, specification, and selection, embedding in the standards program, and then successful education of teams toward implementation—that's two years, three years, five years—so, unless you have the commitment from leadership and the resources to sustain a multiyear effort, you'll be disappointed. It will fail because you didn't understand the commitment required" (Kaiser, Kouletsis).

"Once you head down this path, you're in it for the long run. You can't suddenly say, 'Hey, now that there's a new administrator and he doesn't want to do this so now we've got to make changes.' By this time, you're so far along, you can't go in and change out the glass because that means you've got to change your mechanical system because everything is so integrated: materials, glass, window locations, heat gain, heat loss. Not to mention there's a lot at stake in creating this environment, from its architecture and engineering, and with the expectations that have already been created for the doctors that you're trying to recruit.

Once they get involved in the process, they have their stake in the place they're going to go work" (Dell Children's, Bell).

Section C: Framing the benefits back to communities

On recruitment, retention, and performance

Summary Statement 13: The multiple benefits associated with sustainable building reflect a comprehensive breadth of financial indicators beyond what is conventionally accounted for in return-on-investment analyses. Sustainable buildings create work environments that positively impact staff recruitment, performance, and retention.

For an industry historically challenged by higher-than-average turnover rates (and higher-than-average associated risks, given the nature of hospital operations), enhancing recruitment and retention is a compelling bottom-line, measurable financial benefit. "If we provide the right workplace environment for staff, and they are able to focus on taking care of people instead of themselves, then we ought to be able to measure it in terms of our customer service without patient loyalty scores and all the other measurables. So we need to create an environment where people want to work. We can hire the best and the brightest" (Palomar, Covert).

In fact, some Tier 3 early adopters are already seeing evidence that their green buildings are positively impacting recruitment. "In the first six months of this year, three cancer surgical specialists contacted us. They heard about St. Mary's and The Lacks Cancer Center. They wondered what it was about, having heard about it from family members, and wanted to promote their surgical specialty" (The Lacks Center, McCorkle).

"I've been told that two or three of our latest recruits have come because of the building. I truly believe the fact that because we achieved a LEED standard, and then went above and beyond, is one of the reasons they're coming. Environment is huge, and it helps us recruit and retain our researchers" (BC Cancer, McNeil).

"I believe that a lot of folks come to work at this hospital, believe in this hospital, stay in this hospital because a lot of what they want to do is steward the environment" (Boulder, Abelkis).

Even before the buildings are completed, improved recruitment through a better work environment is a perceived benefit. "Nurses who've been in small hospitals with no access to daylight will say, 'I'd really like to go work at Children's.' We have already started getting so many calls from physicians from out of town who have heard about this project, who want to come here, that it's creating a difficulty because we only need so many heart surgeons, for example. I'm sitting on two resumés right now for people in two different surgical subspecialties that I don't think we have enough clinical throughput to support. But they want to come here" (Dell Children's, Bonar).

Another consideration associated with green building design features and operational protocols is occupant and staff well-being. Creating a workplace that models an environment of care protective of the well-being of building occupants—such as using nontoxic cleaners, providing day-lit workspaces and breakrooms, and ensuring enhanced air quality—contributes to staff retention and also boosts performance, including reducing sick days and workers' compensation claims. "We wanted to personalize the staff's experience so that they would choose us over someone else" (San Juan Regional, Frary).

"We did a research study that confirmed that the cleaning products we were using before caused the employees to call in sick a lot. This is before the Greening the Cleaning program was implemented. Their eyes were all red, and different illnesses were happening. When we changed the program, it all went away, and our workers' compensation claims went down" (Hackensack-Gabrellian, Imus).

"My environmental services people are the happiest people in the agency lately. And I wonder if it's not because they're working with such nice materials. There's a sort of worker-respect aspect of green cleaners that sends a message to a group of people who generally feel undervalued that somebody actually cares about their occupational exposure and the materials they work with. It makes them more energized to do their jobs, the way respect energizes all of us. If you can cut sick days and absenteeism by 10 percent, you're saving tens of thousands of dollars" (Discovery, Dollard).

Staff recruitment, retention, and performance are among the most impressive benefits derived from sustainable building initiatives. These benefits are well-documented in the green commercial office-building sector, though not yet broadly recognized in the healthcare sector. Our sector-specific results, demonstrated through these interviews, reveal a consistent positive correlation between green buildings, staff recruitment and retention, and performance and provide a bottom-line justification for green building on financial payback terms.

"Understanding that the people who work for us are also members, that their health is important to our success and mission, and that they are in our buildings for extended time periods. If you can reduce sick days, reduce injuries, there's a business case around those issues that both benefits the bottom line and improves the relationship with employees. The same thing is true with patient safety. A lot of these new sustainable materials appear to improve patient safety and connect to other environmental initiatives as well. This program fits well into a larger program at Kaiser: The Three Safety's: Patient Safety, Workplace Safety, and Environmental Safety" (Kaiser, Cooper).

On the occupant experience
Summary Statement 14: Tier 3 organizations provide for an improved occupant experience in their facilities with better connection to nature, occupant control, and enhanced air quality.

Healthcare facilities have an extraordinary opportunity to create an experience that enhances patient healing and motivates the highest level of staff performance. "What we've found in green design is that we make a commitment from the very beginning about the job and what it means. There's a lot at stake in creating this environment, from an architecture and engineering side, in terms of working here, and with the expectations that have already been created for the doctors that you're trying to recruit. Once they get involved in the process, they have their stake in that this is the place they're going to work" (Dell Children's, Bell).

"Many of the students going through medical school are getting master's degrees in public health along with their doctorate in medicine. It used to be that they'd get it in biochemistry or research of some kind. Now they're looking into public health."

— **Leo Gehring**

While contributing to delivering the essential programmatic functions, these results also yield favorable financial outcomes. In creating a coherent template for twenty-first century hospitals, these high-performance, Tier 3 facilities rely on a consistent palette of design features, healthy materials, and attention to building orientation and form that contribute to an enhanced human experience.

From the patient perspective, benefits associated with sustainable buildings include decreased length of stay, reduced reliance on medication, and lessened mental and physical stress. While our interviewees were not asked to evaluate this, many offered anecdotal evidence of satisfied patients.

"We've asked our patients how they rate the environment of the building and have seen a dramatic shift in response toward 'acceptable' and 'appreciative.' So it is with the creation of different spaces and the increase in light, and the quietness, and with all these different kinds of materials that we have created this environment" (The Lacks Center, McCorkle).

"One of our goals was to bring natural light into 100 percent of the occupied spaces in the building, and we have achieved that in the area of probably 90 to 95 percent. Within our organization we have framed that in the context of research that demonstrates the positive impact for patient, families, and staff" (Dublin Methodist, Herbert).

"Since we have such nice weather, we definitely wanted to have outdoor spaces. We kept shade in mind, also. For the patients, we built a healing garden. With each private room, we have a balcony for accessing fresh air. The balcony itself overhangs the floor below and provides shade. The rooms are oriented to reduce heat gain. Plus, the balconies are great spaces for patients and families to walk outside right off the room" (San Juan Regional, Frary).

These measures also create improved working conditions for the facilities' medical and management staff. "Having a green building has been this remarkable opportunity for 1,000 staff to experience the building and realize how remarkable air quality can be if it's handled right" (Discovery, Dollard). "I asked Mr. Ferguson whether we could replace all toxic cleaning agents with nontoxic ones. As soon as that was all eliminated, they felt better, and it said to them, 'My boss is looking out for me'" (Hackensack-Gabrellian, Imus).

Providing opportunities for building occupants to control their environment is an expression of respect and enables people to act on their values through choices that are offered. "It's the little things that make a difference. Both the operable windows and the dual-flush toilets are moments where a person interacts with the building to elicit control over resource use. 'How much water am I going to use?' You've given them more than personal control—you've provided them with a way to live their values" (BC Cancer, McNeil).

On financial effectiveness
Summary Statement 15: Sustainable building improves financial effectiveness in part because it fortifies team buy-in and public support.

For Tier 3 organizations such as Dell Children's, the goal is not to create a green facility as a public display (i.e., a trophy), but rather to create one as part of a sound development plan where the financial effectiveness of reducing long-term operating costs is as important as being a good neighbor. Many are developing life-cycle cost analyses or cost methodologies that recognize operational savings in making first-cost decisions.

"What we've found in using LEED is that we make a commitment from the very beginning about the job and what it means. It's not about buying points. We're not going to throw money or do meaningless things for the sake of points. The financial assessment that was completed showed we would save $6 to $8 million in operating expenses in about the first fifteen years of operations. And in working with Austin Energy to develop energy costs, we came to the conclusion that the project had to pay back in less than eight years. So that was part of the business decision on some of the LEED points" (Dell Children's, Bell).

"Life-cycle cost assessment is thoroughly embraced, because we understand that it's about the total cost of ownership—not only the first cost. We are a healthcare company and it permeates throughout the system—that the benefits you get from best practice, efficient operations accrue to the system" (Kaiser, Cooper).

In some instances, sustainable building assists organizations in obtaining public financial support for their capital project. One example is Palomar Health, which garnered tremendous public support to back a $250 million revenue bond package for a proposed new hospital, campaigning on a commitment to deliver an unprecedented level of care to the community.

"When we passed Proposition BB, the community invested in us. This is what makes that significant: 70 percent of the people in our district voted for us, even though only 60 percent actually use our services. That means other people who don't come here were willing to take money out of their pockets to invest in us as an organization" (Palomar, Covert).

Boulder is a telling example of earning community support. The benefit of being able to provide services in a town where residents had come to expect them was an undeniable asset for the city. In Boulder, the city incorporated the parcel, allowed the hospital to mitigate wetlands issues, and collaborated with the hospital to assure acquisition of all necessary federal permits.

"The City of Boulder votes in council members who are strong in the arena of quality of life and environmental stewardship. They're willing to improve upon those and, with Boulder and Boulder County growing in leaps and bounds, we felt this was the perfect time to build a new standalone hospital. It was an unincorporated parcel that the city had already identified for development. So, we readily wanted to support that" (Boulder, Abelkis).

BC Cancer worked with the city to overcome floor-area limitations and parking requirements, waive property taxes, and, in exchange, create a facility for top-level scientists from around the world that messaged both health and quality of life. Spaulding opted for the former Boston Naval Yard site to gain a waterfront location that supports its aquatic programs and partnered with the City of Boston and other public authorities to facilitate zoning changes and site remediation.

Dell Children's was motivated to shift its campus from a suburban, greenfield site to a downtown site with the City of Austin's incentive to put the project on a fast track. "We came back downtown when the city council indicated that they would work collaboratively with us and try to speed up the process that would allow us to acquire the downtown parcel" (Dell Children's, Bell).

The list goes on. The most significant aspect is summed up well by Dollard's statement, whose goal was to create a facility on a site that once contained an industrial operation: "We had a good partnership with Governor [George] Pataki's office and the health department. We all were convinced it might be really beneficial to create a green building. All the while, I felt I needed to convince my board that this was the right thing to do. Or actually, they never need to be convinced. I needed to work hard with my board to find a way to help fund this" (Discovery, Dollard).

The health benefits of a sustainable facility are immediately understood. But for many organizations, garnering board support still requires the chief executive officer to make a compelling financial case for the sustainable building. Increasingly, that financial justification can be bolstered by the economic bottom-line benefits that accrue from healthy building and environmental stewardship.

For others, sustainable building is seen as a market differentiator—a way to separate healthcare organizations in an often-crowded marketplace. "The marketing people are taking companies that might want to join Kaiser through the facility and talking about how the design answers the mission statement. There was a local small company that had always said there wasn't enough market differentiation between Kaiser and our competition—after the visit to Modesto, they signed up on the spot. Another broker reported that the initiatives were really going to resonate with their business customers" (Kaiser, Kouletsis).

Palomar is using sustainable design as a featured selling point and, more importantly, as a tool for broad organizational alignment. "It takes about eighteen months to get our plans through the state here, and we'll have the plans to them in the fall. Then it will be another eighteen months before we can even get started. ... It's a $987 million project that, because of a Kresge planning grant, was able to host a community charrette. We decided it would be a great opportunity for us to bring in some of the potential community partners who might help us think more broadly because of their expertise. [These partners

included people representing energy and water utilities, pollution control, and future-oriented business-es.] There were some good practical recommendations. The question becomes, How do we start working with it now in terms of our renovation projects?" (Palomar, Covert).

On fund raising and development
Summary Statement 16: Insofar as healthcare relies on public support and private philanthropy for its capital projects, sustainable design will continue to drive and invigorate the process.

Few Tier 3 organizations tied their early funding and development campaigns to the quest for a sustainable facility. But for those that did, dollars tied to green building positioned them ahead of the curve. One of these pioneers is Dollard, who, because of his agency's nonmedical purpose as, essentially, a residential campus and school, immediately searched for supplemental funding sources. "From day one we needed to be alert to the budget. ... It was and continues to be a challenge to build green." He explains that receiving a Kresge Foundation grant became a "major boost, because it validated to my board that this was a good thing to do."

The same is true for the Children's-Pittsburgh. Very early in the fund-raising process, leaders were able to obtain a state grant $5 million toward the greening of the hospital. It was management's sense that getting the grant well before finishing the preliminary design alleviated a lot of questions about possible tradeoffs between first dollar and longer-term operating costs. "I haven't had to go through that same justification process that some of the others have done," says Oxendale (Children's-Pittsburgh).

Collaborations such as these are truly a hallmark of the pioneering process Tier 3 organizations use to manifest their vision. The Arkansas COPH received a large sum of money through the nationwide tobacco lawsuit settlement. COPH administration, together with the Colleges of Medicine and Nursing Deans and Department of Health officials, agreed to direct the settlement funds to construct the school at a time when others were opting for roads and airports. "When we started the project, it was absolutely based on the idea that what we needed was a process and an enlightened view of public health" *(Arkansas COPH, Gehring)*.

For Tier 3 healthcare organizations, reliance on a healthcare mission as the singular justification for green building is often not enough. "Locally, even nationally, we're blessed to have a very progressive environmental community" (Providence, Glass). Providence operates in five western states from Alaska to California. The system includes twenty-seven acute-care facilities and employs 46,000 people. The Providence Newberg Medical Center in Newberg, Oregon, is the first medical facility to receive LEED gold certification. "Our employees and our community really had tapped into the idea of a sustainable building in healthcare being a more healing place" (Providence, Beam).

Indeed, for many, having a sound business model in place is essential. "We had available to us about $195,000 in business energy tax credits, but we didn't have the tax burden to take advantage of it," remarks Providence's Beam. With the foundation, he pulled together a philanthropic venture, a public-private sector partnership of sorts, whereby a privately owned company in Newberg was able to take the $195,000 in tax credits and return, in exchange value, $143,000 for the construction of energy conservation features that were budgeted into the hospital and later built.

Numerous other instances of creative financing and structuring of a business case exist. Dell Children's received a $25 million gift to support construction of a replacement facility. Even with those unanticipated funds in hands, the project team was tasked with delivering a project that was financially compelling. In working with Austin Energy on an on-site combined heat and power plant, Dell Children's was able to reinvest about $6 million that otherwise would have been part of the capital cost of providing a central plant. "Since they built our central plant, and we're paying for it over the years through our utility costs, we were able to roll back the savings into the project for other green features" (Dell Children's, Bell).

The hospital is expecting to set precedent with a LEED platinum rating. "We're less than 1 percent of the overall number of hospitals in the United States, but we train over half of all pediatric specialists. So people look at children's hospitals and expect them to be leaders" (Dell Children's, Bonar).

Similarly, The Lacks Center was primarily funded through philanthropy. Richard S. Lacks Sr. provided the lead gift and had approached the hospital after both his father and grandfather had died of cancer. His primary focus was that any family should not have to be inconvenienced by traveling out of state for care, as his family had done. But, in addition to the lead gift, Peter Wege, a local environmentalist and major benefactor throughout the process, made his gift contingent upon sustainable design. "We have had lots of requests from press to talk about the LEED factor. But remember, it's a cancer center that's LEED-certified, not a LEED-certified building that happens to be a cancer center" (The Lacks Center, Benz).

For those who entered the design process without a firm commitment to sustainable building, they were transformed by what they learned and are moving forward with a firm resolve that green building fundamentally resonates with mission. "Frankly, we're getting used to doing it this way. ... So we have another building coming up, a major building, a cancer hospital, and we're going to do it again," (Hackensack-Gabrellian, Ferguson).

Hackensack University Medical Center, like others, will continue to aggressively seek financial assistance to pursue this agenda. "There's a real sense out there that if we could just find that capital, that incremental capital to make better choices about how we build and operate facilities, we should do that. And I think there's a demand out there for it" (Providence, Beam).

On certified performance

Summary Statement 17: Tier 3 organizations are increasingly using green building rating tools. Their use accelerates market transformation, normalizes sustainable design practice, and aggregates benefits.

Since the release of the U.S. Green Building Council's LEED in 1999 and the *Green Guide for Health Care* in 2003, green building initiatives have benefited from common frameworks and accessible methodologies to guide design, construction, and operations decisions. "It's certainly a very efficient, environmentally friendly building that we delivered, using the LEED standards as a tool for figuring out how we can deliver a better building" (Arkansas COPH, Gehring).

With thousands of projects now engaged nationwide in virtually every market segment, these tools establish thresholds, measure performance, and generate market signals to shift toward a bill of materials, products, and equipment informed by a life-cycle view of environmental impacts.

"Using the Green Guide, we developed a checklist—Category 1 points are items incorporated in our Kaiser standards—these become the minimum requirements for our project teams. Category 2 are items that are reasonably simple to implement with a modest amount of research by us or our project teams. Strategies that teams are looking at include operable windows, renewable energy, or hybrid chiller plants, or innovative materials. We believe the process will produce a stronger base of better, smarter buildings for Kaiser, based on a standard, while responsive to local community and individual team vision" (Kaiser, Cooper).

Indeed, in mid-2006, there are six LEED-certified healthcare facilities, with dozens more in the pipeline, and more than one hundred *Green Guide* pilot projects. Collectively, these represent more than 40 million square feet of healthcare construction. Projects registered with LEED are seeking independent, third-party certification, and those in the *Green Guide* pilot are using a voluntary, self-certifying toolkit of best practices for design, construction, and operations.

Interview participants include the first in the healthcare sector to achieve LEED certification (BC Cancer, Boulder, Discovery, The Lacks Center, Providence), a signifier of Tier 3 leadership.

Others are LEED-registered and are pursuing LEED certification, to be awarded at completion of construction. These include Children's-Pittsburgh, Dell Children's, and Hackensack-Gabrellian. Virtually all of these used the *Green Guide* informally, or as a registered pilot, as a source of healthcare-specific guidance and for internal baselining and benchmarking to support continuous improvement.

"There's a wonderful trend among people who are very interested in the environment, including those who set up the criteria for certification, and for planners in healthcare to look at the criteria and then make them more appropriate for our needs. The *Green Guide for Health Care* is one of those wonderful happenings right now" (U-M Mott, Kelch).

Part III: Closing

Lawrence (2000) sums it up this way: "Just as we have responsibility for providing quality patient care, just as we have responsibility for keeping our facilities and technology up to date, we have a responsibility for providing leadership in the area of the environment. The stakes are extraordinarily high. We have to keep folding these questions and these considerations back into our leadership. We have to incorporate them into our incentives, into what it is we're held accountable to do, how we measure our impact. We all know the old saw, 'No margin, no mission.' But as a colleague said, 'Without the mission I don't want to get up in the morning.' Competing effectively is a need that we all have, but it isn't what healthcare is about. It's about improving the health of the communities we serve."

The Tier 3 leaders interviewed for this paper demonstrate that the industry is responding to Lawrence's challenge. All these institutions demonstrate that sustainable values are embedded in their mission and vision, and, as market awareness, tools, and incentives evolve, this massive industry is rising to realize its fundamental objective to improve the health of the communities it serves. This recognition builds environmental leadership and awareness of the linkages between human health and the environment. Out of this awareness, a comprehensive vision of improved performance is emerging—one that unites construction and operation to yield triple bottom-line benefits—economic, social, and environmental.

Recognition for these activities builds leadership. When the *Green Guide* was developed, it was based on the assumption that health-based green building standards—standards grounded on the idea of protecting occupant, community, and global health—would resonate with leading healthcare organizations and that those organizations would move forward to actualize better buildings that respond to this mission. What was less apparent then, but is now becoming clear, is how this goal of improved performance would resonate with the communities surrounding these institutions—and how these healthcare leaders would move past sustainable strategies that deliver operational improvements to seek a broader, more meaningful set of health benefits—or, in the legal parlance of community benefit, promoting health for the benefit of the community.

> "Life-cycle cost assessment is thoroughly embraced, because we understand that it's about the total cost of ownership—not only the first cost. We are a healthcare company and it permeates throughout the system—that the benefits you get from best practice, efficient operations accrue to the system."
>
> **— Tom Cooper**

These organizations are connecting to their communities in new ways. Sustainable building demonstrates, in bricks and mortar, that healthcare organizations can reflect the values of the communities they serve—in environmentally progressive communities, their environmental leadership is considered essential to maintaining and increasing market share.

These leaders are advocating for Smart Growth policies, economic development, and remediating environmentally damaged sites. They are modeling healthier lifestyle choices to their patients and staff, through initiatives ranging from transportation alternatives to housing relocation incentives,

organic food to open stairs that encourage walking behaviors. As this century unfolds, they are recognizing that their buildings are in the service of humans, rather than simply receptors of the latest medical technology. And finally, these leaders recognize the high cost of inaction on matters of the environment on the health of our families, neighbors, and communities at hand and globally.

As they begin to understand the benefits, Tier 3 leaders recognize that sustainable building and operation has the capacity to keep generating benefits, from the inception of design through occupancy and beyond. Many already report positively around recruitment and retention. A high degree of occupant satisfaction—often associated with choice, control, and the ability to live one's values—accompanies the completed projects. Financial benefits, ranging from reduced operating expenses associated with energy and water reduction to lower staff turnover—are proudly recounted.

For the most part, leaders report that there are modest first-cost increases attributable to their sustainable building initiatives—but there are varying approaches to dealing with those challenges and successfully overcoming them. As Providence's Beam so succinctly framed it: "There's a real sense out there that if we could just find that capital, that incremental capital to make better choices about how we build and operate facilities, we should do that. And I think there's a demand out there for it."

How do these Tier 3 organizations emerge from their Tier 2 counterparts? For some, it's the connection to an expressed stewardship mission. For others, its visionary leadership, either from the chief executive officer or board level. For still others, it's the opportunity that a private philanthropic gift presents, tied to a broader vision of health and the environment. However it occurs, once these leaders come forward, they continue to move forward through multiple projects and operational improvement initiatives. Without exception, they find that their leadership vision inspires and transforms their organizations. No one emerges from the process unchanged.

Throughout history, there are traceable, identifiable moments when, upon reflection, a critical mass is in place that creates conditions for transformation. Such a moment—healthcare's tipping point—is approaching. The resurgence of healthcare institutions as definers of community wellness and public health reinforces their civic leadership stature. The opportunity to rekindle healthcare's values-driven legacy to "First, do no harm" deserves the environmental health community's full acknowledgement and support.

Author Biographies

Robin Guenther, FAIA, is principal of Guenther 5 Architects, a twenty-person New York City firm with extensive experience in healthcare design. Her work has been published nationally and internationally in magazines such as *The Architectural Review, Interior Design, Contract, Architectural Record*, and *Healthcare Design*.

Last year, Guenther was awarded The Center for Health Design's Changemaker Award for her efforts to continuously improve and support change in the healing environment. She is a co-coordinator of the *Green Guide for Health Care* and serves on the LEED for Healthcare Committee. She is currently co-authoring (with Gail Vittori) her first book, *Sustainable Architecture for Health*, to be released in 2007 by Wiley and Sons.

Gail Vittori is co-director of the Center for Maximum Potential Building Systems, a nonprofit sustainable planning and design firm established in 1975, located in Austin, Texas. Since 2000, Vittori has been engaged in numerous green healthcare initiatives and currently is a co-coordinator of the *Green Guide for Health Care* and chair of the U.S. Green Building Council's LEED for Healthcare Committee.

Vittori was a Loeb Fellow at Harvard University's Graduate School of Design from 1998-1999 and serves as secretary of the U.S. Green Building Council's board of directors. She is co-author (with Robin Guenther) of *Sustainable Architecture for Health*, to be released in 2007 by Wiley and Sons.

Cynthia Atwood is a designer and special projects coordinator who directs much of the creative and communications activity of New York City-based Guenther 5 Architects. As one of a few helping to pioneer the next generation of improvements in health and healthcare delivery, Atwood was invited to join The CARITAS Project as a professional delegate member to China (2007). This delegation will attempt to determine the extent that design leadership plays a role in making systematic and sustainable improvements to health and healthcare design. In addition, Atwood is an adjunct professor with Pratt Institute's Interior Design Department in Brooklyn, New York.

Notes

[1]   A recent study by PricewaterhouseCoopers' Health Research Institute estimates that the total tax benefit of exemption (federal, state, and local) for a 300-bed average community hospital equals about $6.5 million annually.

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Appendix: Table of Interview Subjects

**BC Cancer Agency
Research Centre
[BC Cancer]
Vancouver, BC**
Operated by the
BC Cancer Agency

**Mary McNeil,
President & CEO**
BC Cancer Foundation
(Owner)

DESIGN FACTS
- LEED gold (CaGBC) clinical research laboratory facility owned by the foundation
- Completed one day ahead of schedule and $6 million under budget
- 42% energy reduction with no use of HCFCs and 43% water use reduction, including waterless urinals
- Diverted 98.5% of the construction waste from the landfill; 24% recycled construction and finishing materials

ANECDOTES
- A concerned citizens' group established the British Columbia Cancer Foundation over 70 years ago at a point when the cancer survival rate in B.C. was the lowest in Canada
- The first recorded donation to the foundation was $50 from the Native Daughters of BC, Post 1, in 1935

SCOPE
$95 million/230,000 sf with an expected Phase II 160,000 sf facility adjacent

Open: 2005

Accommodates 60 principal scientists and up to 600 scientific and medical personnel

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**Boulder Community
Foothills Hospital
[Boulder]
Boulder, CO**

**Kai Abelkis,
Environmental
Coordinator**
Boulder Community
Hospital

DESIGN FACTS
- ASHE Vista Sustainable Design Award 2005
- LEED silver community acute-care hospital, the first hospital in the nation to receive USGBC third-party LEED certification
- Cost of achieving LEED estimated at 2% of construction cost
- Central Utility Plant expected payback of 7 years
- 2006 Environmental Leadership Award from Hospitals for a Healthy Environment (H2E)

ANECDOTES
- Has an active reduce, recycle, reuse program since 1990 that has saved 4,524,300 gallons of water, 2,848,400 kilowatt hours of electricity, and more
- Central utility plant supplies energy efficiently with an expected savings at $95,000 year and at 30% lower use than ASHRAE standards
- 32 acres of the 49-acre site have been dedicated back to the city as permanent open space; the site was an unincorporated parcel, formerly used to graze cattle; portions lie within a federally designated floodplain

SCOPE
Three-story 60-bed, 154,000 sf facility includes a 24-hour emergency department

Complemented by a new 67,000 sf outpatient services building

49-acre site is master planned for 400,000 sf and will occupy 17 ac of the site

Cost: $52 million

Operational since 2003

Children's Hospital of Pittsburgh of UPMC [Children's-Pittsburgh] Lawrenceville, PA

Roger A. Oxendale, President & CEO
Children's Hospital of Pittsburgh

DESIGN FACTS
• Project employs the principles of sustainable design and construction (seeking LEED), using innovative practices such as off-site parking and shuttle services for construction crews due to the site's location in a densely populated residential area

• The new Clinical Services Building will tie into the 330,000 sf of existing space in the south wing of the former St. Francis Medical Center it is scheduled to replace

• Relocation to an expanded and renovated prior hospital site in central Pittsburgh

ANECDOTES
• Recipient of a Heinz endowment grant

• UPMC has a Center for Environmental Oncology that is working to transform building operations to greener, safer modalities

• Creating a comprehensive green healthcare system in partnership with the City of Pittsburgh

SCOPE
$425 million, 1.287 million sf complex includes an 883,000 sf nine-story hospital and ambulatory-care facility (Clinical Services Building)

Project includes an eight-story 174,000 sf research facility, parking for 1,400 vehicles, and 200,000 sf combined for faculty and administrative offices

40,000 employees (UPMC), the largest employer in the region

Last year it provided $175 million to academic programs and $200 million in uncompensated care and community services

Scheduled to complete in 2007

C.S. Mott Children's & Women's Hospitals [U-M Mott] Ann Arbor, MI

Robert Kelch, MD, CEO, U-M Executive Vice President for Medical Affairs + Patricia Warner, MPH, Associate Hospital Director, Children's & Women's Services
University of Michigan Health System

DESIGN FACTS
• The Children's & Women's project is registered through LEED and is part of a 3 million sf master plan across three locations in Ann Arbor owned by the university

• Project received a $25 million contribution from the C.S. Mott Foundation

• Project will replace the facility that currently houses the Mott and Women's Hospitals; both hospitals have grown outdated since their respective 1969 and 1950 openings and are unable to meet the current demand

ANECDOTES
• UMHS has raised $48 million toward the hospital, including a portion through the sale of blue rubber wristbands (that allow community members to participate)

• Kelch oversees all three components of UMHS: the hospitals and health centers, with more than 11,000 employees and a 2003 operating budget of $1 billion; the medical school, which has more than 2,100 faculty and 1,500 students and trainees and received more than $290 million in research awards for fiscal 2002; and the M-CARE managed-care organization, which has 203,000 members

SCOPE
264-private bed, $523 million facility

Planned 1.1 million sf facility includes a nine-story clinic tower and a twelve-story inpatient tower

855,000 sf are designated for in-patient space, 245,000 sf for clinic and office space, 180,000 sf shell space to accommodate growth

Groundbreaking scheduled for fall 2006, with a scheduled completion by early 2011

Dell Children's Medical Center of Central Texas [Dell Children's] Austin, TX

Robert Bonar, President & CEO
Children's Hospital of Austin
+ Alan Bell, Director of Design & Construction
Seton Family of Hospitals

DESIGN FACTS

• Anchors the redevelopment of the former Robert Mueller International Airport brown-field site in central Austin and replaces the current Children's Hospital of Austin upon completion

• Seeking LEED platinum certification for innovative and comprehensive sustainable strategies; project is a registered pilot of the *Green Guide for Health Care*

• Recipient of a $25 million gift from the Michael and Susan Dell Family Foundation

ANECDOTES

• The construction site has reduced the use of Portland cement by 31% and has also diverted two-thirds of its construction debris

• Seton Family of Hospitals collaborating with the City of Austin and Austin Energy to build a district energy plant on site

• Chose location to conform to Austin's Smart Growth initiative

• Catalyst for adoption of sustainable design and construction strategies in other new Seton facilities

SCOPE

$110 million, 169-bed, 455,000 bgsf hospital to serve 46 counties

Includes a 35,500 bgsf combined heat and power plant (CHP) at a cost of $18 million

Open: June 2007

Dublin Methodist Hospital [Dublin Methodist] Dublin, OH

Cheryl L. Herbert, RN, President
Dublin Methodist Hospital, OhioHealth

DESIGN FACTS

• A Pebble Project of The Center for Health Design

• Located just outside Columbus, OH, and in a projected growth market for the OhioHealth System, the new community hospital will provide care to community residents and support the practice of evidence-based design in the construction of its facility

ANECDOTES

• Achieves daylighting in 90% of all occupied spaces in the building

• Utilized a team process based on the slogan "Run until apprehended" to invigorate and inspire design innovation and contractor diligence

SCOPE

$150 million, 94-bed facility with expansion capacity to 300 beds

300,000 sf facility on an 89-acre campus

Scheduled to open late 2007

Kaiser Permanente Templated Hospital [Kaiser] Modesto, CA

John Kouletsis, AIA, National Director, Planning & Design Services + Tom Cooper, Manager, Strategic Sourcing & Technology
Kaiser Permanente

DESIGN FACTS
- Kaiser Permanente's Templated Hospital Project will guide construction and renovations of more than 20 Kaiser healthcare facilities by 2013
- The Kaiser Permanente Modesto Medical Center is one of four templated hospitals currently under construction whose designs were based on the *Green Guide for Health Care's* principles of environmentally friendly, sustainable design

ANECDOTES
- Kaiser's Modesto Medical Center is part of a greater than $20 billion capital spending program that includes 27 new or replacement hospitals over a 12-year plan; in 2006 alone, Kaiser Permanente plans to spend more than $3 billion
- The Templated Hospital Project helps to ensure hospitals are built for the future; emphasize patient, staff, and environmental safety; and contribute to improved workflow and patient outcomes

SCOPE
Kaiser Permanente Modesto Medical Center

Anticipated completion: early 2008

670,000 sf on 50 acres, including a 386,000 sf five-story hospital with two nursing towers, a 254,000 sf medical office-ancillary services building with ambulatory surgery, and a 29,000 sf central utility plant

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Palomar Medical Center West [Palomar] Escondido, CA

Michael Covert, CEO + Carrie Frederick, Director, Performance Excellence
Palomar Pomerado Health

DESIGN FACTS
- Registered as both a *Green Guide for Health Care* pilot project and as one of The Center for Health Design's Pebble projects
- Received a Kresge Foundation Planning Grant to conduct a pre-planning ecocharrette
- The planned new facility is scheduled for 35 acres at the Escondido Research and Technology Center business park, west of Interstate 15

ANECDOTES
- Both city and hospital district officials will work together on the design and have proposed forming a citizen's committee from each to advise during the design phase
- The new medical center is the cornerstone of a 10-year, $1 billion master plan for the public hospital district and is the largest such undertaking in its history

SCOPE
A planned 453-bed, 1.2 million sf flagship medical center

Anticipated cost: $690 million

Anticipated groundbreaking: 2007 with a planned opening date in 2010

Providence Health & Services [Providence] Northwest USA, including Newberg, OR, and Olympia, WA

John Koster, MD, CEO, Providence Health & Services

Richard Beam, Director, Energy Management Services, Office of Supply Chain Management, Providence Health & Services

+ Geoffrey Glass, PE, Director, Facility and Technology Services Providence St. Peter Hospital

DESIGN FACTS
- LEED gold — Providence Newberg Medical Center, nation's first
- ASHE Vista Award for 2005, Renovation Category – Providence St. Peter
- Piloted sustainable design principles in the expansion/ renovation of St. Peter

ANECDOTES
- 2004 US EPA Energy Star Partner of the Year for Leadership in Energy Management
- Financial support for PNMC included business energy tax credits through the Oregon Office of Energy, grants through the Energy Trust of Oregon's Building Efficiency Program, and funding approval through PGE's Earth Advantage Program for a combined 14-month return on investment
- Updated, expanded, and new facilities and programs are part of a $1.2 billion investment over 3 years

SCOPE
Providence Newberg Medical Center (PNMC) is a 56-acre, 41-bed, 143,000 sf licensed hospital + 44,000 sf medical office building

Cost: $70 million

Open since June 2006

Providence St. Peter Campus Renewal Project (PSPH) 105,000 sf project; cost: $43.3 million

133 acre campus, 390-bed regional medical center (Olympia, WA)

Open since August 2004

San Juan Regional Medical Center [San Juan Regional] Farmington, NM

Doug Frary, Vice President of Support Services San Juan Regional Medical Center

DESIGN FACTS
- A major level III trauma center expansion with associated renovation work
- Implemented sustainable design strategies using the conceptual framework of the LEED Green Building Rating System and Experience Economy 'storytelling' techniques

ANECDOTES
- SJRMC is a privately owned, community-governed nonprofit hospital and is one of the largest employers in the state
- House Bill 266 created a $4.7 million trauma fund to support existing and incentivize new trauma facilities to join the state's system
- Steve Altmiller, CEO, honored as New Mexico Grassroots Champion by the New Mexico Hospitals and Health Systems Association

SCOPE
Multilevel 156,000 sf addition and major renovation project

Existing 168-bed acute-care hospital with a $55 million renovation and expansion

Phase 1 occupancy: August 2006

**Spaulding
Rehabilitation
Hospital [Spaulding]
Boston, MA**

**Judith Waterston,
President**
Spaulding Rehabilitation
Hospital Network, a
member of Partners
HealthCare System and
a teaching affiliate of
Harvard Medical School

DESIGN FACTS
• Project is registered as a pilot of the *Green
  Guide for Health Care* after having been intro-
  duced to this document and other
  sustainable design principles at the Boston
  Design for Health Summit

• The new facility will replace the current
  Spaulding facility on Nashua Street and will
  join a growing neighborhood of preeminent
  biotech and life-sciences companies in the
  Charlestown community

• Working in partnership with City of Boston,
  Mayor Thomas Menino, and the Boston
  Redevelopment Authority to locate the $100
  million facility into the former Charlestown
  Navy Yard brownfield site

SCOPE
Preliminary plans: $100 million,
150-private room facility with
indoor aquatics, conferencing,
a public green space, and
underground parking

Planned opening: 2011

**The Discovery Health
Center [Discovery]
Harris, NY**

Patrick H. Dollard, CEO
Center for Discovery

DESIGN FACTS
• ASHE Vista Sustainable Design Award 2004

• LEED v2.0 Certified; *Green Guide for Health
  Care*

• The first Department of Health licensed
  medical facility in New York State to
  implement green standards; first LEED-
  certified diagnostic and treatment facility

• Awarded grants through the New York State
  Energy & Research Development Authority
  and the Kresge Foundation

ANECDOTES
• 42% additional energy savings over base
  model comparison using ground source
  heating and cooling (geothermal)

• Material selection based upon low-emitting
  and healthier materials for improved indoor
  air quality

SCOPE
$6 million, 28,000 bgsf
specialized diagnostic and
treatment facility

Open: 2003

Located on a 350-acre campus
that includes residential services
for more than 250 medically
fragile and developmentally
disabled adults and children

1,000 employees; largest
employer in Sullivan County

The Lacks Cancer Center at St. Mary's Health Care [The Lacks Center] Grand Rapids, MI

Philip H. McCorkle Jr., President & CEO + David Hathaway, Manager of Construction Projects + Micki Benz, Vice President for Development
St. Mary's Health Care

DESIGN FACTS
- Certified LEED 2.0 silver facility, making it the second hospital and fourth healthcare facility in the nation
- Site selection: new comprehensive cancer center on an existing medical center campus
- A $10 million donation by the family of Richard S. Lacks Sr. jumpstarted the campaign

ANECDOTES
- Peter Wege, a Grand Rapids philanthropist and environmentalist set the goal for St. Mary's Health Care to create a green building and become a steward of health with construction of this facility
- The project received points from LEED because food cooked to order uses less energy and results in less waste than the traditional cafeteria model
- Self-cleaning windows not only save energy and human resources, but result in a healthier, cleaner environment for patients

SCOPE
175,000 sf facility

42 private rooms, four surgical suites, a chapel, a rooftop garden, and the Warren Reynolds Patient Information library

Open: January 2005

The Sarkis and Siran Gabrellian Women's and Children's Pavilion at Hackensack University Medical Center [Hackensack-Gabrellian] Hackensack, NJ

John Ferguson, President & CEO + Deirdre Imus, Founder, Deirdre Imus Environmental Center for Pediatric Oncology + Suzen Heeley, Director of Design & Construction + Anne Marie Campbell, Chief Public Affairs Officer/Director, Public Relations
Hackensack University Medical Center

DESIGN FACTS
- Seeking LEED certification and registered as a pilot of the *Green Guide for Health Care*
- Project awarded a $1 million Kresge Foundation challenge grant used toward the construction of the Pavilion
- Project includes The Joseph M. Sanzari Children's Hospital, The Women's Hospital, and The Mark Messier Skyway for Tomorrow's Children

ANECDOTES
- The Environmental Oncology Center has made significant strides in raising awareness among lawmakers about the potential hazards of environmental toxins; Imus has helped them sign into law several related bills
- HUMC adopted the use of environmentally friendly cleaning products throughout by implementing the Deirdre Imus Environmental Center Greening the Cleaning environmental protocols

SCOPE
HUMC is a 781-bed facility and is Bergen County's largest employer (workforce: 7,100)

Hackensack-Gabrellian is a 300,000 sf facility with two separate and distinct lobbies for each of the hospitals

192 private rooms

Cost: $117 million

Operational since 2005

**UAMS College of
Public Health
[Arkansas COPH]
Little Rock, AK**

**Leo M. Gehring, CHFM,
SASHE
Vice Chancellor for
Campus Operations**
University of Arkansas
for Medical Sciences

DESIGN FACTS
• ASHE Vista Team Award 2005

• Academic educational facility used
  principles of sustainable design throughout
  to improve health of building occupants:
  healthier materials, reduced energy demand,
  and modeling of health behaviors

• Built a facility to represent a statewide
  stance on public and environmental health

ANECDOTES
• Facility recently named for the late Dr. Fay
  Boozman, director, Arkansas Department of
  Health [Fay W. Boozman College of Public
  Health for Arkansas]

• Boozman played a key role in steering
  millions of dollars to this and other
  health-related causes

• The college is responsible for developing
  programs that reach into the communities
  and make Arkansas a healthier state

SCOPE
120,000 sf, partially funded by
$15 million from the state's
tobacco settlement money

Operational since 2002

9,000 employees (UAMS),
the largest public employer
in the state

Economic impact: $4.3 billion
per year (UAMS + affiliates)

Occupancy: 2,220 students +
660 residents

Creating Safe and Healthy Spaces: Selecting Materials that Support Healing

Mark Rossi, PhD, and Tom Lent

Introduction

> A consistent ethic means that our healthcare organizations must change practices...we see a clear link between environmental responsibility and our basic mission, which is to provide quality healthcare services to all.
>
> There is a direct link between healing the individual and healing this planet. We will not have healthy individuals, healthy families, and healthy communities if we do not have clean air, clean water, and healthy soil.
>
> **— Lloyd Dean, Chief Executive Officer, Catholic Healthcare West, 2000**
> **(Setting Healthcare's Environmental Agenda Conference)**

Every year hospitals consume huge volumes of materials. In 2004 alone, the healthcare sector consumed $23 billion worth of durable medical equipment and $32 billion worth of nondurable medical equipment, while investing another $86 billion in structures and medical equipment.[1] This scale of consumption creates both concerns and opportunities.

The concerns stem from how the plastics, metals, fibers, and minerals used in healthcare construction and medical devices affect our health. Materials matter, as Kenneth Geiser wrote in his book by the same title, because as "we mine, synthesize, process, distribute, use, and, finally dispose of materials, we generate worrisome threats to the sustainability of the ecological systems upon which we depend."[2] As one of the largest economic sectors in the United States, healthcare is a major contributor to the impacts of material consumption.

The opportunities emerge from the position of healthcare—by mission, expertise, and scale of activities—to address material concerns in ways that not only reduce the footprint of their facilities but affect larger change across the medical product industry and even the entire construction industry.

This paper outlines the relationship of the materials and products used in a modern healthcare facility to the chemicals to which our communities are exposed. It emphasizes the opportunities available to healthcare organizations to help society break from its dependence upon toxic materials and define the path to healthier, sustainable materials that benefit patients, communities, nature, and the organizational bottom line. The task is large, but a wide range of healthcare organizations have already outlined manageable steps—see "Recommendations"—that can lead facilities to gain the benefits of the use of healthier, green materials.

Case studies in greening materials

Healing from the inside out

Creating a healing environment requires paying attention to all that patients take into their bodies. In our healthcare facilities, we make sure that the water is pure and that our patients get enough of it. We

Recommendations

First steps

- Adopt purchasing policies that clearly state a preference for green materials that are protective of health and maintain the highest standards of patient care.
- Incorporate green building material preferences into design goals early in capital projects.
- Use the plastics spectrum as a guide when specifying plastic-based products.
    - Prefer polypropylene and polyethylene plastics that do not contain hazardous additives and sustainably-sourced biobased materials.
- Give preference to low VOC products.

Next steps

- Require suppliers to disclose chemical and material content of products.
- Avoid materials that contain highly hazardous chemicals. Start with chemicals listed in Appendix 3.
- Prefer materials and products with high recycled content and end-of-life recycling programs.

Fully engage

- Partner with suppliers who manufacture and develop products using green materials.
- Require suppliers to provide comprehensive hazard data on the chemicals contained in materials and products.

take great care to ensure that each patient receives the exact dose of pharmaceuticals he or she needs. Increasingly hospitals are paying attention to the food patients eat, seeking healthy, balanced meals and avoiding chemicals by increasing the use of organic foods. The air patients breathe is just as important.

We close windows and set up filter systems on outdoor air intakes to protect against outdoor pollutants entering the hospital. Unseen, however, is an influx of toxic chemicals into hospitals from building materials. The materials that cover the floors, walls, and ceilings release hundreds of different chemicals into hospital air. Furniture, curtains, casework, and office and medical equipment contribute their share. Finally, the chemicals used to clean and maintain hospitals add even more to the toxic chemical soup.

Volatile organic compounds (VOCs) such as formaldehyde, acetaldehyde, naphthalene, and toluene are released into the air from particle board, carpets, and other finish materials to be inhaled by patients and staff alike. Semivolatile compounds such as phthalates and halogenated flame retardants latch on to the dust and float into breathing spaces. The potential implications can be subtle but significant, including effects ranging from longer patient recovery times to more sick days for staff.

The health effects from building materials reach farther than the occupants of the building, stretching into the broader community. Roof coatings and paints spread VOCs into the surrounding air contributing to smog. Particulates kicked up by construction and spewed with other carcinogens from exhaust pipes and smokestacks threaten the lungs of residents in the area.

The effects don't end with the local community. Design decisions play out across the whole life cycle of the materials brought into hospitals, starting with the extraction of the raw materials and their manufacture into building materials and medical products. Plastics, for example, have been a boon for the production of high-performance finishes and medical equipment, but at a cost to human health and the environment. Drilling for the oil and gas from which plastics are made releases cadmium, mercury, and a host of other toxic chemicals such as xylene, arsenic, chlorophenols, and polycyclic aromatic hydrocarbons into the environment. The hazardous releases continue at petroleum refineries, which emit lead, naphthalene, benzo(a)pyrene, and other toxic chemicals. The trail of toxic chemical emissions continues at each subsequent step along the path to manufacturing a final plastic product. Polyvinyl chloride (PVC) production alone contributes releases of dioxins, furans, ethylene dichloride, and vinyl chloride monomer. End-of-life disposal continues the saga with the release of yet more toxic chemicals.

The life cycle of materials paints a sobering picture. The very building materials we use to shelter and nurture our patients and the medical devices with which we attempt to heal them contribute chemicals to the air they breathe that can cause the diseases we seek to cure. With the boom under way in health-

care construction today—estimated at $65 billion in 2006[3] and growing rapidly with increases projected to be 10 percent to 15 percent in 2006 and 2007,[4] the industry is poised to bring many more toxic materials into the environment. Or not. Significant players in the healthcare industry have been looking at this construction boom not as problem but rather as an opportunity—a unique opportunity for the industry to leverage changes in the entire building materials industry far beyond healthcare.

Hackensack cleans up

Tackling the whole range of health and environmental issues raised by the array of materials and products used in a modern healthcare facility can be very daunting. Yet an increasing number of facilities are showing that it can be done—often starting with small steps that lead with time and experience to bigger steps. For Deirdre Imus, founder and director of the Deirdre Imus Environmental Center for Pediatric Oncology at Hackensack University Medical Center (HUMC), it started with cleaning chemicals.[5]

"Research regarding the kinds of things that can cause cancer...led me to finding out about hazards associated with some ordinary, everyday cleaning agents—and then to wondering what sorts of things were being used to sanitize places where kids were being treated and cared for," said Imus. "Hospitals," she continued, "are supposed to be places of healing. So it doesn't make sense to expose sick patients to potentially harmful chemicals and gases."

A discussion with HUMC President and Chief Executive Officer John Ferguson in the winter of 2000 led to an investigation of healthier alternatives to the traditional commercial cleaning products. Their research showed that traditional cleaning products were loaded with known or suspected human carcinogens, hormone and endocrine disruptors, and neurotoxins. In response to these findings, they developed a Greening the Cleaning program for the hospital, which included a list of hazardous ingredients to avoid in cleaning agents (see Appendix 1). Small-scale tests provided a proving ground for alternative products. Now the program has developed into a full-scale cleaning protocol across the facility based upon environmentally friendly, nontoxic cleaning products that utilize natural or naturally derived ingredients.

Beyond cleaning: VOCs from building materials

Their concern with the chemicals introduced into the healthcare environment from cleaning products grew to include chemicals released from the materials used in HUMC facilities, including building materials. Suzen Heeley, director of design and construction for HUMC, frames this as a logical part of the effort to create healthy spaces: "You can't just create a healing environment," said Heeley, "with visual amenities alone."

HUMC staff learned that standard particle-board millwork, doors, fiberglass insulation, paints, stains, finishes, adhesives, and sealants all are commonly made with urea formaldehyde and other VOCs that are known or suspected carcinogens and asthma triggers among other health concerns. As design progressed for the new Women's & Children's Pavilion, "we looked holistically at pollutants in the environment from materials, seeking to avoid those that would have potential negative impacts on the occupants of our building, on our community, and beyond," explained Heeley. They found that they could use wheat/straw-board material for millwork and recycled cotton insulation instead of fiberglass. Both of these products had no added formaldehyde plus the benefit of using more rapidly renewable resources. Low VOC paints, stains, finishes, adhesives, and sealants all contributed to cleaning the air for the new facility as well.

Material of concern: PVC

Polyvinyl chloride (PVC) or vinyl plastic avoidance has become one of the major material issues for HUMC—both to reduce immediate health impacts on patients and staff and because of its health impacts elsewhere in its life cycle. In taking steps to avoid the use of PVC in interior finishes and medical prod-

ucts, HUMC (the fourth largest hospital in the United States) is joined by Kaiser Permanente (the largest nonprofit health maintenance organization in the United States), Catholic Healthcare West, and many other hospitals, including three of the four healthcare projects[6] certified under Leadership in Energy and Environmental Design (LEED)[7] and two-thirds of the more than 100 projects from around the United States participating in the *Green Guide for Health Care* pilot program.[8]

Polyvinyl chloride or vinyl first became an issue of concern for the healthcare industry in the mid-1990s when the US Environmental Protection Agency (EPA) released data showing that medical waste incinerators were one of the largest single sources of dioxin emissions. The irony of hospitals emitting large amounts of this incredibly potent carcinogen triggered a strong reaction in the healthcare community. In addition to shutting down incinerators, the healthcare sector started reducing PVC use in disposable medical products, which are a source of chlorine—a necessary ingredient in the formation of dioxins in incinerators.[9]

Further study of PVC revealed it to be a plastic to avoid on many counts. Dioxin formation is not restricted to the burning of PVC, but is also one of a host of toxic byproducts of PVC manufacture. Hazardous additives may be added to give PVC its useful characteristics, including lead and organotins to stabilize it and phthalate plasticizers, like di-2-ethyl hexyl phthalate (DEHP), to give it flexibility. Lead is a neurotoxicant and DEHP is a reproductive toxicant—a particularly serious concern for neonatal intensive-care unit patients.[10]

Leveraging the building materials industry to get the PVC out

With growing success in creating markets for PVC-free medical devices, attention in the healthcare sector has turned to building materials where PVC is found in flooring, carpet backing, wall coverings, upholstery, pipes, and more. Environmental rating systems for buildings around the world, like the *US Green Guide for Health Care*,[11] Australia's *GreenStar*,[12] and Environmental Building News' *Green Spec*[13] have begun to acknowledge the value of PVC elimination. Today, healthcare project designers in the United States, Europe, and Australia are starting to deselect PVC materials.

Alternatives to PVC-based materials abound in construction in general. But finding alternatives that meet healthcare's exacting performance needs can sometimes be challenging, especially in areas where PVC has become the standard and options are limited and/or more expensive. Undaunted, some healthcare systems—most notably Kaiser Permanente—recognize their considerable purchasing power and are challenging manufacturers to develop products that have better environmental and health attributes with equal or better performance and cost (see "Changing the Course of Production: Kaiser Permanente"). The plethora of new products that have moved into the market in the last couple of years heralding their no-PVC content and other environmental-health attributes is a testament to the power of healthcare to shift markets.

Moving to green materials

Substitution unlocks bottom-line gains

When hospitals search for environmentally preferable alternatives, they can make a powerful discovery: doing the right thing for health and the environment can leverage sizable unexpected benefits to the bottom line. HUMC and Kaiser Permanente are two examples of a growing number of healthcare organizations to make the switch from vinyl (PVC) flooring plastic to other flooring materials, such as synthetic rubber, polyethylene, and polypropylene. While environmental concerns prompted the search for vinyl-free flooring, they soon discovered economic benefits as well.

As HUMC and Kaiser Permanente evaluated alternative flooring systems, they first discovered that most options were modestly more expensive per square foot to install than vinyl. Further analysis revealed that,

while initial capital costs were higher, life cycle costs were lower for many PVC-free options. Rubber flooring, for example, provides better stain resistance and eliminates the wax-and-strip maintenance cycle of vinyl. Eliminating the wax-and-strip cycle not only reduces maintenance costs, but it also improves staff health by avoiding exposure to the chemicals used in stripping and waxing and solves the major logistical challenges of scheduling this maintenance in 24/7 facilities. Rubber has also been very popular with nursing staff due to its better acoustics and tendency to be easier on staff feet when standing on it for long hours. Very significantly, it also looks like the higher friction coefficient of many PVC-free flooring alternatives may dramatically reduce slip/fall accidents with the potential for significant payoffs in reduced staff and patient injuries.

Changing the Course of Production: Kaiser Permanente

Environmental activism emerged within Kaiser Permanente four decades ago when the organization invited Rachel Carson, author of *Silent Spring*, to deliver the keynote address to a large symposium of physicians and scientists. Today, the 8.5 million member organization with 145,000 employees and $31.1 billion in annual revenues has become a national environmental leader in the healthcare sector. Driving Kaiser Permanente to invest in the environment is the recognition that the health of its members is affected by the health of the communities they live in.

Purchasing specifications and partnerships

In the mid-1990s Kaiser Permanente began incorporating environmentally preferable purchasing specifications into contracts for medical, chemical, and building products. Mercury-free thermometers, PVC-free medical and building products, latex-free examination gloves, greener cleaners, and recyclable solvents are among the many product changes implemented over the past ten years. The power of large-scale purchasing to drive changes in the market is demonstrated in the case of how Kaiser Permanente catalyzed innovation in the carpet sector.

In the summer of 2002, Kaiser Permanente set out to find a high-performance, environmentally preferable carpet. To evaluate whether a carpet is indeed environmentally preferable, Kaiser Permanente asked leading manufacturers detailed questions about the impacts of their products from cradle to grave. For product content, Kaiser Permanente evaluated the carpets for PVC content, other persistent bioaccumulative toxics (PBTs), carcinogens, and postconsumer recycled content. For sustainable manufacturing practices, Kaiser Permanente assessed the progress carpet-manufacturing facilities are making in minimizing waste, water use, nonrenewable energy, and air emissions. For the use stage, the company examined whether the carpets posed problems to indoor air quality, including off-gassing volatile organic compounds—that new carpet smell. For the end-of-life stage, carpets were evaluated on whether they can be closed-loop recycled (carpet to carpet) or down-cycled (carpet to other products of lower value). This scale of investment in evaluating the environmental performance of products sets Kaiser Permanente apart from its peers.

The decision: Catalyze innovation

After evaluating the products and the company responses, no carpet emerged that was both PVC-free and met Kaiser Permanente's demanding performance specifications. The ideal product, it turned out, did not yet exist. Lacking the ideal product, Kaiser Permanente added an innovation question to evaluate the interest, commitment, and capacity of suppliers to develop a new product that met its needs. "Kaiser Permanente," Tom Cooper of Kaiser Permanente's Standards,

Planning, and Design team emphasized, "is seeking to develop long-term partnerships with companies that are committed to developing the products we need."

With the goal of creating a new product, Kaiser Permanente chose two vendors on the understanding, specified in a contract, that they would develop a PVC-free product with the necessary performance characteristics at the same cost as existing products within two years. The contract required each firm to submit quarterly reports, including indicators of progress toward PVC-free backing. One of the firms ran into difficulties, fell behind schedule, and stopped communicating with Kaiser Permanente. The other firm, Collins & Aikman (C&A), met the challenge.

"In direct response to our request, C&A developed a new durable, low-emission, PVC-free carpet with backing made primarily from postconsumer recycled plastic," said Cooper. The achievement earned C&A a sole source contract with Kaiser Permanente. In responding to Kaiser Permanente's challenge, C&A created a new carpet line for the firm and for other healthcare and institutional uses. The C&A trademarked "ethos" carpet is made with a PVB [polyvinyl butyral] backing, a chlorine-free material that is recovered from PVB laminate in automobile safety glass. The C&A carpet backing is made from more than 75 percent postconsumer recycled product, which can be recycled into more carpet backing at the end of its life. The combination of mission, capacity to evaluate products, willingness to partner with suppliers, commitment to reducing PVC use, and market size of Kaiser Permanente led C&A to design a new carpet product.

Excerpted with permission from Clean Production Action, Healthy Business Strategies for Transforming the Toxic Chemical Economy, *http://www.cleanproduction.org/Publications.php.*

Getting started: Setting goals

Whether an organization is just starting or is already incorporating environmental priorities into material purchasing policies and facility-design protocols, it is important to set overarching organizational goals. Kaiser Permanente, for example, framed its environmental goals for building design in terms of community health in March 2002 in the "Kaiser Permanente Position Statement on Green Buildings":

> "Kaiser Permanente's mission is to improve the health of the communities we serve. In recognition of the critical linkages between environmental health and public health, it is Kaiser's desire to limit adverse impacts upon the environment resulting from the siting, design, construction, and operation of our healthcare facilities. We will address the life cycle impacts of facilities through design and construction standards, selection of materials and equipment, and maintenance practices. Additionally, KP will require architects, engineers, and contractors to specify commercially available, cost-competitive materials, products, technologies, and processes, where appropriate, that have a positive impact, or limit any negative impact on environmental quality and human health."

Important elements of this vision include examining the life cycle of the facility and the materials used inside. The life cycle of a facility includes design through construction, operation, and maintenance and, ultimately, demolition. The life cycle of a material differs in that many stages, including extraction of raw materials, manufacture, and usually disposal, all occur outside of the hospital's boundaries. Only installation, use, and maintenance of a material's life cycle occur within the hospital. Thus, a comprehensive approach to materials requires a broader perspective.

HUMC is an example of a growing number of healthcare organizations that are explicitly making the connection between their healing work and the causes of the potential diseases they treat. In its mission statement, Deirdre Imus Environmental Center for Pediatric Oncology states: "The Deirdre Imus

Environmental Center for Pediatric Oncology at Hackensack University Medical Center represents one of the first hospital-based programs whose specific mission is to identify, control, and, ultimately, prevent exposures to environmental factors that may cause adult, and especially pediatric cancer, as well as other health problems with our children."

With this mission, HUMC has made improving indoor air quality and avoiding materials responsible for some of the worst toxic chemicals released into the global environment its top priorities when evaluating the environmental performance of building materials.

Defining green materials

The work of HUMC, Kaiser Permanente, and other businesses inside and outside of healthcare reveals an emerging path for defining and selecting environmentally preferable or green materials. We define a green material[14] as having the following key properties:

- No toxic chemistry: Uses only green chemicals in production, use, and disposal. Green chemicals are those that are healthy to humans and the environment and are produced in accordance with the twelve principles of green chemistry (see Appendix 2).

- Biobased or recycled content: Is manufactured from sustainably grown and harvested plant resources or postconsumer recycled content.

- Reusable, recyclable, or compostable: Avoids disposal at the end of its useful life through refurbishment, reuse, recycling into an equivalent product (closed-loop recycling), or composting into soil.

Other properties relevant to the sustainability of a material across its life cycle include: efficiency of water, energy, and materials use; use of renewable energy sources; and maintaining and supporting labor and human rights. Some healthcare organizations such as Kaiser Permanente have made the important first step of questioning suppliers about their consumption of resources, generation of waste, and labor practices when evaluating products.

Our definition of green materials is informed and supported in part by the US Green Building Council's Leadership in Energy and Environmental Design system[15] and the *Green Guide for Health Care*.[16] LEED, for example, prioritizes recycling, renewable materials, and materials that reduce the off-gassing of VOCs into the building. The GGHC expands upon LEED's priorities on materials to address community and global health issues, strengthen the standards on indoor air quality, and broaden the range of chemicals addressed.

Criteria for the transition to green materials

Since green chemistry is practiced by few companies and few materials on the market come close to fully meeting our definition of a green material, attaining truly green materials on a large-scale basis will require patience, persistence, and constant demand from consumers large and small. Progress is being made toward greener materials by consistent signaling to manufacturers about the environmental health priorities of the healthcare industry. Kaiser Permanente and HUMC, for example, are helping move markets to greener materials by developing environmental specifications and partnering with suppliers that are willing to meet them.

The Green Materials Hierarchy for Healthcare defined in Table 1 represents our synthesis of the developing consensus in the healthcare industry on what constitutes greener materials. The hierarchy provides an initial set of criteria, a version 1.0, for defining greener materials that are achievable today.

They are not a comprehensive set of directions to achieving truly green materials—rather they define an initial set of steps that start us along the path to green materials. These guidelines are deeply influenced by our concerns with the use and exposure of humans and the environment to toxic chemicals. For this reason, they start with screening to eliminate materials that contain or contribute to the release of highly hazardous chemicals.

Criterion 1: Persistent organic pollutants

At the top of the hierarchy is the elimination of the use of materials that contribute to the formation of persistent organic pollutants (POPs) as specified by the Stockholm Convention on Persistent Organic Pollutants.[17] Such materials are the top priority because POPs are a set of chemicals so hazardous to human health and the environment that the international community has agreed on the need to eliminate their production, use, and release into the environment. The persistent and bioaccumulative nature of these chemicals makes them a hazard to the entire world community regardless of where they are produced. Under article 5(c) of the convention, ratifying nations agree to "Promote the development and, where it deems appropriate, *require the use of substitute or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C [emphasis added]*" (which includes dioxins and furans)."[18]

Dioxins and furans are the POPs of greatest relevance to materials because both the production and incineration of some materials, especially those containing chlorine, unavoidably contributes to their formation.[19] The *Green Guide for Health Care* prioritizes avoidance of *chlorinated compounds, especially PVC and cement from kilns fired with hazardous waste* to avoid dioxin emissions.[20] PVC plastic is by far the largest volume plastic made with chlorine and is the only plastic whose production is listed by the US EPA in its inventory of dioxin emissions.[21] Cement kilns fired with hazardous waste (much of it chlorinated) rate in the US EPA's top ten sources of dioxin.[22]

Criterion 1 is a baseline requirement, a prerequisite, to starting on the path to green materials. If the manufacture, use, or disposal of a material creates as a waste product any chemical on the list of Stockholm POPs, then it is not an environmentally preferred material. To use the contracting language of Kaiser Permanente, criterion 1 is a go/no-go criterion: to go forward in the contracting/purchasing process the specification, in this case meeting criterion 1, must be met.

Criterion 2: Highly hazardous chemical content and emissions

Eliminating materials that *contain or emit* highly hazardous chemicals is the next level in the hierarchy because the use of such materials can result in patient and worker exposure to toxic chemicals in hospitals. At the top level is criterion 2a, eliminating the use of materials that contain persistent, bioaccumulative, and toxic (PBT) or very persistent and very bioaccumulative (vPvB) chemicals. These chemicals are similar to POPs—being persistent, bioaccumulative, and toxic in nature means they very are likely to pose global problems; additionally, national governments are targeting them for elimination. Appendix 3 lists PBT and vPvB chemicals as identified by governments. If a material contains a PBT or vPvB chemical above one hundred parts per million (i.e., 0.01 percent), then it is not allowed on the path to green materials.

Plastics, for example, trigger criterion 2 when a highly hazardous chemical additive is used to give them a particular performance characteristic. The flame retardants polybrominated diphenyl ethers (PBDEs) are such an example. Added to plastics to enhance their fire resistance, PBDEs are PBTs and are of significant concern in the United States because Americans have the highest concentrations of PBDEs in their bodies. A plastic that contained PBDEs would fail criterion 2.

At the next levels of criterion 2—2b and 2c—are avoiding materials that *contain or emit* other highly hazardous chemicals, including carcinogens, reproductive toxicants, neurotoxicants, endocrine disruptors,

Table 1: Green Materials Hierarchy for Healthcare

Criterion 1: Do not use materials that contribute to the formation of persistent organic pollutants (POPs) as defined by the Stockholm Convention.

Criterion 2: Do not use materials that contain or emit highly hazardous chemicals, including:
   a. Do not use materials that contain
      1. Persistent, bioaccumulative, toxics (PBTs) or
      2. Very persistent, very bioaccumulative (vPvB) chemicals
   b. Avoid materials that contain
      1. Carcinogens
      2. Mutagens
      3. Reproductive or developmental toxicants
      4. Neurotoxicants
      5. Endocrine disruptors
   c. Avoid materials that emit criteria levels of VOCs.

Criterion 3: Use sustainably sourced biobased or recycled and recyclable materials.

   a. Prefer sustainably produced biobased materials that are:
      1. Grown without the use of genetically modified organisms (GMOs).
      2. Grown without the use of pesticides containing carcinogens, mutagens, reproductive toxicants, or endocrine disruptors.
      3. Certified as sustainable for the soil and ecosystems.
      4. Compostable into healthy and safe nutrients for food crops.
   b. Prefer materials with the highest postconsumer recycled content.
   c. Prefer materials that can be readily reused or recycled into a similar or higher value product and where an infrastructure exists to take the materials back.

Criterion 4: Do not use materials manufactured with highly hazardous chemicals, including those described in criterion 2.

acute allergens (for example, latex), and VOCs. VOCs have been related to sick building syndrome and a range of bronchial and other chronic problems.

The use of DEHP in PVC medical devices is an example of the need for criterion 2b.[23] It is a reproductive toxicant that is added to the material PVC. When used in medical devices, DEHP leaks from the product and exposes the patient. Yet alternative materials to PVC are widely available, none of which contain DEHP. People should not be exposed to highly hazardous chemicals from materials or products in a place of healing when safer alternatives exist. A challenge to implementing criterion 2 is learning which chemicals are contained in or emitted from a material or product and determining the hazards they pose. Strategies for addressing these challenges are discussed below.

Criterion 3: Biobased or recycled and recyclable

The third criterion in the hierarchy moves to specifying the materials we want, rather than the materials we don't want. These are the renewable materials produced from crops and forests and recycled materials.

Biobased materials are desired because, if sustainably produced, they will be available for generations, unlike materials based upon the use of virgin fossil fuels, which we are rapidly depleting. The significant clause here is, *if*, since the majority of current farming and forestry practices are unsustainable and unhealthy for multiple reasons. Current practices depend upon a high consumption of fossil fuel for energy and chemical inputs. They degrade and deplete the soil and ecosystems on which they depend. They use large amounts of toxic pesticides and other chemicals as well as increasing amounts of genetically modified organisms (GMOs).

To address the *if* issue, we specify in Table 1 conditions that will put renewable materials on the path to sustainability, including: grown without the use of GMOs and highly hazardous pesticides, grown with sustainable soil and ecosystem practices, and manufactured so as to be safely compostable. Compostability means the material can be biodegraded in a short period of time into healthy nutrients—containing no hazardous substances—for soil and crops.

Recycled materials are desired because they avoid the significant environmental impacts of extracting and producing virgin raw materials. In addition to saving limited virgin raw material resources, recycling processes typically release fewer toxic chemicals and require less energy than virgin production. The greater the percent recycled content of a material the less impact from virgin material production.[24] The most desirable recycled content is postconsumer content—meaning material that is recycled after used by end users. Postindustrial (or preconsumer) recycled content is material recycled after manufacturing but before consumer use. Note that recycling alone is insufficient to make a material green; it must be combined with the reduced use of toxic chemicals (criteria 1, 2, and 4).

Recyclable means that the material can be recycled into a similar product. Material recycling should be closed-loop, meaning the material can be turned into a product of similar or higher value. This usually requires designing the product to enable separating the different materials at the end of its life. To be meaningful, the technical design to be recyclable must be accompanied by manufacturer take-back programs or other local development of infrastructure to support recycling.

Table 2: Rationales for Green Material Hierarchy for Healthcare

Criterion	Reasons for Action
1. Do not use materials that contribute to the formation of Stockholm Convention Persistent Organic Pollutants (POPs).	• POPs are highly hazardous. • POPs circulate and accumulate globally. • Governments have identified POPs as a top priority for action and agreed to a global treaty for elimination (Stockholm Convention on POPs).
2. Do not use materials that contain or emit highly hazardous chemicals.	• Government agencies have identified these as priority health hazards. • These highly hazardous chemicals escape from materials in the healthcare environment. • Patients and healthcare workers may be exposed to these chemicals.
3. Use sustainably sourced biobased or recycled and recyclable materials.	• Create sustainable material supply systems. • Reduce environmental impacts from virgin material production and from agriculture.
4. Do not use materials manufactured with highly hazardous chemicals.	• Reduce exposure of communities outside the hospital walls to high hazard chemicals. • Improve wider community and ecological health.

Criterion 4: Highly hazardous chemicals in manufacturing

The fourth criterion in the hierarchy focuses on eliminating the use of highly hazardous chemicals in the *manufacture* of the material, whether they end up in the final product or not. Here the concern is with exposures to communities—human and ecological—beyond the walls of the hospital. Take the example of the plastic material, polystyrene. The primary building block of polystyrene is the chemical styrene—which is a possible carcinogen. When styrene is converted into polystyrene, it is no longer carcinogenic. Yet the workers manufacturing styrene and polystyrene, and the communities adjacent to these facilities, are exposed to styrene. Hospitals as healing centers have a responsibility to use materials that are safe and healthy—not only for the patients they serve, but also for the broader community of which they are part. The plastics spectrum in Figure 1 will help in implementing this criterion.

Table 2 summarizes the reasons for action for each of the four criteria in the Green Materials Hierarchy for Healthcare. The placement of each criterion is a function of our values of prevention, precaution, and concerns for environmental health as well as the practice of healthcare today, where leading organizations are already implementing the hierarchy. In the following sections, we apply the criteria to a group of materials widely used in healthcare—plastics—as well as materials that contain VOCs.

Putting the criteria into practice

Specifying preferable plastics

Since many products used for interior finishes, furniture, and medical products are made from plastics, plastics are the largest consumer of organic chemicals,[25] and many threats to health and the environment are related to plastics production and use, plastics provide a good place to start in implementing the Green Materials Hierarchy in a healthcare facility. The criteria in the hierarchy can be applied to plastics to provide guidance on selecting the healthiest options.

Figure 1 provides a guide for purchasers and specifiers on plastics, ranging from the worst plastic (PVC) through increasing preferability of the fossil fuel-based plastics to the most preferred plastic (sustainable biobased plastics). Shifting specifications to plastics further to the right on the spectrum will reduce health impacts and increase sustainability.
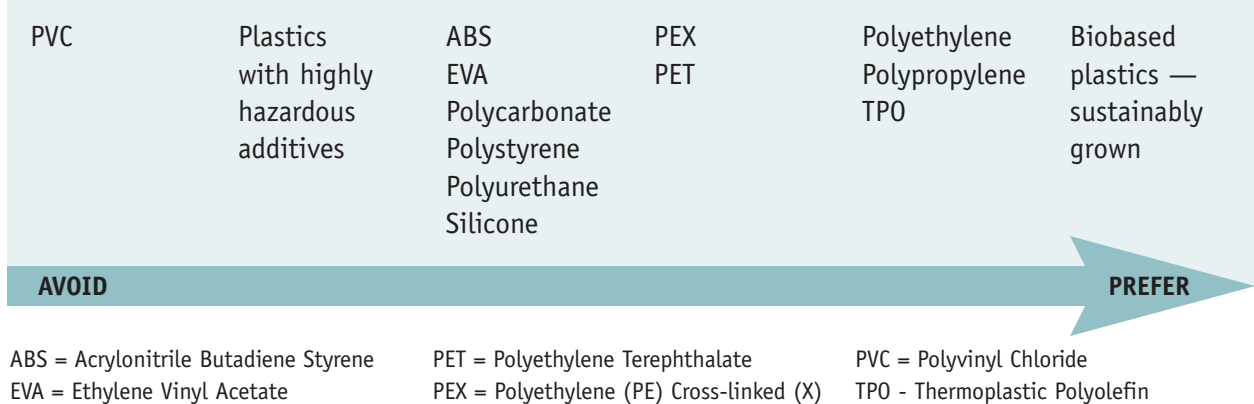
Plastics whose production or disposal contributes to the formation of Stockholm Convention POPs (criterion 1)

PVC is the least preferred plastic of the plastics listed in Figure 1. Because of its chlorine content, PVC production, inadvertent fires, and waste incineration result in emissions of dioxins (a Stockholm Convention POP).[26] Hence PVC triggers the critically important criterion 1. PVC also has problems under the other criteria. Many types of PVC may contain additives that fail criterion 2, including lead, cadmium, and DEHP. With its very low recycling rates—essentially zero recycling in the municipal solid waste stream (see Table 3)—PVC does not score well under criterion 3. Made from the carcinogens vinyl chloride monomer and ethylene dichloride, PVC also triggers criterion 4.[27]

Plastics that contain highly hazardous additives (criterion 2)

Plastics contain many different types of additives: chemicals that are added to a polymer to improve manufacturing and material performance (e.g., durability, flexibility, longevity, aesthetics, etc.). Some of these additives are highly hazardous. For example, PVC coatings used on electrical wire and cable typically contain lead compounds and some end uses of polypropylene and polyethylene (which are typically preferred for reasons discussed below) contain the flame retardants, PBDEs, which are PBTs.

Figure 1. Plastics: Environmental Preference Spectrum

PVC	Plastics with highly hazardous additives	ABS EVA Polycarbonate Polystyrene Polyurethane Silicone	PEX PET	Polyethylene Polypropylene TPO	Biobased plastics — sustainably grown

AVOID → **PREFER**

ABS = Acrylonitrile Butadiene Styrene   PET = Polyethylene Terephthalate   PVC = Polyvinyl Chloride
EVA = Ethylene Vinyl Acetate   PEX = Polyethylene (PE) Cross-linked (X)   TPO - Thermoplastic Polyolefin

Plastics that otherwise would be highly rated on the spectrum for their relatively lower health impacts—such as polypropylene—become problematic materials when highly hazardous chemicals are added. For example, if a plastic contains an additive that is a PBT or vPvB chemical, triggering criterion 2a, it is no longer advancing toward a greener material and it becomes a material to avoid rather than prefer.

Halogenated flame retardants, such as PBDEs, are an example of additives that healthcare systems are beginning to screen from their products and some governments are beginning to regulate. Widely used in polyurethane, polypropylene, polyethylene, polystyrene,[28] and other plastics for flame resistance, PBDEs are PBTs. PBDE concentrations in Americans have been doubling every five years, and animal studies link them to immune suppression, cancer, endocrine disruption, and neurobehavioral and developmental effects.[29]

Other key additives and treatments that healthcare systems are targeting to screen include: phthalates (especially DEHP), stain treatments that require perfluorocarbons (PFCs, especially perfluorooctanoic acid or PFOA), and heavy metals like mercury, cadmium, and lead. Table 4 highlights additives of known concern. Leading systems like Kaiser Permanente and HUMC are moving beyond single chemical exclusions to demand that manufacturers fully disclose all of the chemicals and materials in their products so they can fully evaluate the health and safety of the products for their staff, patients, and the larger community.

Tracking down data on the additives used in plastics is a challenge because manufacturers consider the data proprietary. Healthcare systems and group purchasing organizations need to press manufacturers for the data on additives used in plastics as well as the hazards they pose and be willing to sign nondisclosure agreements if necessary to receive the data.

Use sustainably sourced renewable or recycled and recyclable materials (criterion 3)

The most preferred plastic is nontoxic in its chemistry and renewable. Instead of being made from limited virgin materials like fossil fuels, it is made from a sustainably sourced biobased resource, is closed-loop recyclable, and, ultimately, biodegradable into healthy nutrients for food crops when no longer useable. While few such materials exist, some are closing in on this goal.

Plastics made from plants, the biobased plastics, are the new generation of plastic materials. For example, the plastic polylactic acid (PLA) is manufactured from corn rather than fossil fuels. Biobased plastics like PLA have been in use for some time for select medical products and are now beginning to be used in fabrics and interior finish materials such as carpet and wall-protection systems. Linoleum flooring, wood cabinetry, cotton insulation, and other biobased materials can be placed on the spectrum similarly to biobased plastics. Biobased materials are preferred over fossil fuel-based products in criterion 3 for a wide range of reasons: from their potentially inexhaustible renewable nature to the reduced global

warming impact and avoidance of the human and environmental health impacts of fossil-fuel exploration, extraction, and refining.

Whether these benefits are realized, however, depends upon how the crops they are made from are raised and how the plastic is then manufactured. Today modern agriculture uses vast amounts of fossil fuels, toxic chemicals, and novel biological organisms (GMOs), potentially making biobased plastic materials just as hazardous to our health as their fossil fuel-based cousins. Hence buyers are developing guidelines for biobased plastics to encourage more sustainable practices. Criterion 3 lists a set of principles that form the core of sustainability guidelines for biobased materials:

1. Grown without the use of GMOs.

2. Grown without the use of pesticides containing carcinogens, mutagens reproductive toxicants, or endocrine disruptors.

3. Certified as sustainable for the soil and ecosystems.

4. Compostable into healthy and safe nutrients for food crops.

Watch in the next few years for programs that will certify the sustainability of bioplastics and other bio-materials. For wood, Forest Stewardship Council[38] certification already provides some assurance that the wood was harvested in a sustainable manner avoiding many of the worst environmental practices that plague the timber industry.

Recycling is an important issue for both biobased and fossil fuel-based plastics.[39] Criterion 3 encourages maximizing recycled, preferably postconsumer, content. It also gives preference to those materials that are designed to be easily reused or recycled at the end of their useful life in a closed-loop cycle—meaning, recycled back into products of equal or higher value.

Recycling of plastics from building materials is at an early stage of development. Pilot programs targeted at recycling various specific building material plastics in isolation may demonstrate the technical ability to recycle, but large-scale recycling of these materials must integrate into existing commodity plastic recycling systems to achieve high percentages of recycled content. The current recycling rate of various plastics in the municipal waste stream is a useful indicator of the potential for large-scale recycling of plastics from the building-material waste stream. Among the commodity plastics,[40] PVC and polystyrene

Table 3: Plastic Recycling Rates in Municipal Solid Waste (MSW)

Plastic	Generation (thousand tons)	Recycling (thousand tons)	Recycling Level (percent by weight)
PET	2,870	410	14.3%
High density polyethylene (HDPE)	5,140	470	9.1%
Other plastics	5,080	350	6.9%
Low density polyethylene (LDPE) and Linear low density polyethylene (LLDPE)	6,210	150	2.4%
Polypropylene	3,610	10	0.3%
Polystyrene	2,270	0	0.0%
PVC	1,470	0	0.0%
Total plastics in MSW	26,650	1,390	5.2%

Source: US EPA, 2003, Municipal Solid Waste in the United States: 2003 Data Tables (http://www.epa.gov/msw/msw99.htm)

Table 4: Additives Watch List

Chemical	Type of Additive	Principal Polymers Used In	Hazards Posed
Bisphenol A	Antioxidant	Polyethylene, polypropylene, styrene	Endocrine disruptor [30]
Cadmium compounds	Stabilizer	PVC	Reproductive/developmental toxicant and mutagen[31]
Carbon black	UV light stabilizer	Polyethylene, polypropylene, polyurethane, styrene, PVC and others	Carcinogen[32]
Lead compounds	Stabilizer	PVC	Neurotoxicant[33]
Organotins	Stabilizer	PVC	Reproductive toxicants[34]
PBDEs	Flame retardant	Polyethylene, polypropylene, polyurethane, styrene and others	PBTs (see Appendix 3)
Perfluorinated compounds (Teflon chemicals)	Stain repellant or lubricant surface treatment	many	PFOS[35] (perfluorooctane sulfonates) is a PBT (see Appendix 3) PFOA (perfluorooctanoic acid or C8) is very persistent, possibly carcinogenic and an immunotoxic in animals[36]
Phthalates, especially DEHP	Plasticizer	PVC	DEHP is a reproductive/developmental toxicant[37]

have the lowest recycling rates in the municipal solid waste (MSW) stream—essentially zero (see Table 4). Polypropylene and LDPE/LLDPE (two types of polyethylene: low density polyethylene and low density polyethylene) are recycled, but at low levels (less than 5 percent). Polyethylene terephthalate (PET) and high density polyethylene (HDPE) have the highest MSW recycling rates of the plastics.

PVC is also a contaminant in PET recycling. The presence of PVC in the reprocessing and remanufacturing of postconsumer PET can cause problems. At very low concentrations, PVC can form acids when mixed with PET. These acids break down the physical and chemical structure of PET, causing it to turn yellow and brittle. This renders the PET material unacceptable for many high-value end-use applications. In addition, the presence of PVC may result in hydrochloric acid emissions during PET reprocessing, which can increase the cost of control systems or regulatory compliance.[41]

The placement of fossil fuel-based plastics on the environmental preference spectrum (beyond those that do not fail criteria 1 and 2) depends upon their recycling rates and how they fare on criterion 4 below. Since acrylonitrile butadiene styrene (ABS), ethylene vinyl acetate (EVA), polycarbonate, polystyrene, polyurethane, and silicone are barely recycled, they are less preferable in terms of recycling than PET, polypropylene, and the polyethylenes (HDPE, LDPE, LLDPE).

Do not use materials manufactured with highly hazardous chemicals (criterion 4)

ABS, EVA, polycarbonate, polystyrene, polyurethane, and silicone follow plastics with highly hazardous additives on the environmental preference spectrum because they are manufactured using highly haz-

ardous chemicals and, as discussed above, are seldom recycled. ABS is a copolymer made from three highly hazardous chemicals. Acrylonitrile (A) is an International Agency for Research on Cancer (IARC)-probable carcinogen.[42] Butadiene-1,3 (B) is an IARC- probable carcinogen,[43] as well as being a European Union Category 2 mutagen,[44] and reproductive/developmental toxicant according to the State of California.[45] Styrene (S), which is also the building block of polystyrene, is an IARC-possible human carcinogen.[46] EVA is made from the feedstock vinyl acetate, which is an IARC-possible human carcinogen.[47] Polycarbonate is manufactured from the suspected endocrine-disrupting compound, bisphenol A.[48] Thermoplastic polyurethane is manufactured from a variety of highly hazardous intermediary chemicals, including the IARC known carcinogen formaldehyde.[49] Silicone is manufactured from intermediary feedstocks that include quartz (also known as silica) and methyl chloride. Silica dust is an IARC-known human carcinogen,[50] and methyl chloride is reproductive/developmental toxicant according to the State of California.[51]

Polyethylene terephthalate is manufactured from the possible developmental toxicant ethylene glycol and hence also violates criterion 4.[52] PET is, however, somewhat more preferable to the plastics to the left of it on the environmental preference spectrum—which share similar concerns over highly hazardous chemicals inputs—because it is more readily recycled (criterion 3).

Polypropylene and polyethylene are the most preferred of the fossil fuel-based plastics because their feedstocks, propylene and ethylene, have not been identified as meeting any of our criteria for highly hazardous chemicals—they are not listed as carcinogens, mutagens, reproductive or developmental toxicants, neurotoxicants, endocrine disruptors, or PBTs in any of the governmental databases we searched. Additionally these plastics are, along with PET, the more widely recycled plastics in both municipalities and industries. Thermoplastic polyolefin (TPO) is a blend of polypropylene and polyethylene and is also highly preferred among the fossil fuel-based plastics for similar reasons—less hazardous and recyclable in commercial applications. Note that for polypropylene, polyethylene, and TPO to be highly preferred they must meet criterion 2, contain no highly hazardous chemical additives.

Another polyethylene, cross-linked polyethylene (PEX), is somewhat less preferable than the other polyethylenes because it is a thermoset plastic; which means it cannot be melted down and converted into a high-value product. It can only be ground down and used in filler for generally low-value applications.

Specifying low VOC materials

Paints, stains, adhesives, and other wet-applied products will emit VOCs after application, with emissions tapering off rapidly in the weeks that follow. Furniture, carpets, flooring, and other interior finish products release VOCs more gradually over time. VOCs are the chemicals most commonly associated with sick building syndrome in new buildings or after renovations. Many green building material-rating systems already include screening procedures for interior finish materials based either upon quantities of VOCs *contained* in the product or upon levels of VOCs *emitted* into the indoor air after installation.

A large (and growing) number of standards and certification systems exist that address the release of VOCs from different building materials or products. They include government standards—such as the South Coast Air Quality Management District VOC content regulations for paints, coatings, and adhesives and the California 01350 emissions standard for solid finish materials—and independent third-party certification programs—like GreenSeal for paints, Indoor Advantage and GreenGuard for furniture and finish materials. A recent trend is that an increasing number of green building product-certification programs are being established and managed by trade associations, such as Green Label Plus for carpets by the Carpet and Rug Institute and FloorScore for resilient flooring by the Resilient Floor Covering Institute. This trend is being viewed with increasing skepticism and concern by many observers, given that the associations promulgating these standards were formed to promote the products being tested and to protect the interests of that product's industry.

The most health-protective standards address a large number of individual VOCs using health-science-based criteria with a strong precautionary approach; others just set a total VOC limit and monitor a small number of individual VOCs. It is important to note that there is no material-certification program yet that addresses all potential chemical hazards that a building material can present to occupants. Most of them only address immediate postinstallation exposure to VOCs and a limited set of VOCs at that. Generally, they do not address semivolatile organic compounds (SVOCs) such as phthalates and brominated flame retardants that are released more slowly later in the life of the material, nor do they generally limit heavy metals and other toxic components of materials that may be released as particulate rather than volatilizing.

The ideal indoor health certification program for green building materials will be

- developed with participation of consumer and public health interests and independent of industry control;

- transparent, meaning that the protocols are publicly available;

- not proprietary, usable by multiple certifiers;

- third-party certified;

- incorporating the full range of chemicals of concern related to indoor exposures; and

- clearly related to other standards that address the wider range of green material issues (such as recycled content or lifecycle PBT emissions) or be clearly identified as limited only to indoor exposure issues.

No standard yet exists that meets these criteria. Intense discussion is under way in the certification community to reduce the confusion of different standards currently on the market and develop more comprehensive standards.

VOC standards and certification programs are useful tools for screening building materials for health, but must be approached with awareness of the limitations of current programs and combined with the chemical screening described elsewhere in this paper to truly protect the health of occupants or of the community.[53]

Challenges on the path to green materials

Gaining the benefits of the transition to green materials is not without challenges, including:

- collecting the data needed to evaluate materials and the products they are part of,

- identifying products made with green materials, and

- adjusting work habits to the properties of new materials.

A particular challenge to evaluating the toxicity profile of materials is gaining access to data on the chemical constituents of a material. In fact, many product vendors do not know the materials included in their products nor do they know the chemicals that are in those materials. Gaining data on the chemical and material constituents of products will require deeper partnerships with vendors. Kaiser Permanente's work with C&A on carpets and HUMC's Greening the Cleaning product exemplify how it is possible through persistence to understand the toxics in products and eliminate them.

Some suppliers, such as Herman Miller and Interface, have worked to gain detailed knowledge of the chemicals used in their products as well as the hazards posed by those chemicals.[54] Herman Miller, for example, requires its suppliers to disclose the chemical constituents of their materials down to 100 parts per million.

As a result, Herman Miller knows the chemical composition of all of the parts down to 0.01 percent by weight of some products like its Mirra office chair. But Herman Miller does not disclose publicly or to its customers the chemicals contained in its products.

Once data is collected on the chemical constituents of a material/product, the next challenge is understanding the hazards posed by that chemical. Unfortunately, the majority of chemicals on the market have not been comprehensively tested for their hazards.[55] To acquire comprehensive hazard data requires government action to mandate and coordinate. This reality is leading some healthcare systems such as Kaiser Permanente to actively support government chemical policy reform.

After an organization commits to selecting green materials, the next challenge is finding products that contain them. Do not be surprised if the product does not exist. But, do not be discouraged either. Kaiser Permanente's journey in search of PVC-free carpet illustrates how persistence and a willingness to partner with a supplier can result in new product development that meets price, performance, and environmental concerns. Vendors need to be engaged in the search for solutions and rewarded with contracts when they deliver the product. Of course, as new green materials are developed, it is critical that no standards of performance or patient care be sacrificed. Recent evidence shows that healthcare's huge purchasing volume puts it in a strong and potentially unique position to shape the course of material development by catalyzing manufacturers to market materials that are good for healthcare and the environment.

Finally, once a new material is in place, workers need to be engaged to maximize the benefits of the greener material. For example, both HUMC and Kaiser Permanente have found that, in initial tests, they were not capturing the potential benefits of the reduced maintenance needs of new floorings. Maintenance staff continued to use the old vinyl-floor wax-and-strip methods on the new floors, particularly in areas where the old and new floors coexisted in the same building. Both organizations had to institute a careful training and monitoring program with maintenance staff to help them through the transition, to understand the changes, why they are taking place, and how to work with the new materials.

In another such transition, HUMC found installers were initially skeptical about the switch from fiberglass insulation batts to the recycled cotton. The cotton handles differently, and installers were resistant to try the new product, with which they had no experience. After trying it out, however, the installers discovered that, in addition to avoiding carcinogenic formaldehyde, they didn't get the skin irritation typical of fiberglass handling and felt much better after installing it. Now some of the installers are active proponents and don't want to go back to fiberglass.

Reaping the big bottom-line benefits

Potentially even more powerful than the individual attribute benefits of change in flooring or insulation or paints or blood bags or cleaners can be the effect on staff relations. Creation of a comprehensive approach to addressing the health impacts of the facility on staff, patients, and the community can be framed to highlight the organization's philosophy. This can provide a powerful message of the organization's caring and concern and support gains in professional staff allegiance and retention and in patient satisfaction.

Will greening materials cost more? The answer will vary—some materials substitutions will cost no more, some may even save money. Others may have a higher initial price tag but can leverage tremendous returns. The organization that can break down the barrier between capital and operating budgets and can make links between environmental decisions and staff and patient effects can reap major economic rewards while doing good.

Recommendations

Healthcare organizations can establish a progression of measured steps to steadily improve the health impact of their material purchases.

First steps

- Adopt purchasing policies that clearly state a preference for green materials that are protective of health and maintain the highest standards of patient care.

- Incorporate green building material preferences into design goals early in capital projects.

- Use the Plastics Environmental Preference Spectrum as a guide when specifying plastic-based products.

  - Prefer polypropylene and polyethylene plastics that do not contain hazardous additives and sustainably-sourced biobased materials.

- Give preference to low VOC products.

Next steps

- Require suppliers to disclose chemical and material content of products.

- Avoid materials that contain highly hazardous chemicals. Start with chemicals listed in Appendix 3.

- Prefer materials and products with high recycled content and end-of-life recycling programs.

Fully engage

- Partner with suppliers who manufacture and develop products using green materials.

- Require suppliers to provide comprehensive hazard data on the chemicals contained in materials and products.

Transitioning to greener materials is part of a journey to creating safer and healthier products. It is a journey that will take time, experimentation, adjustments to error—in short, continuous improvement. As the experiences of Kaiser Permanente, HUMC, and others show, however, the potential rewards for the healthcare system are huge. Patient outcomes, staff satisfaction and retention, and operating costs all stand to gain. Healthcare with its large purchasing volume is uniquely positioned to shape the future of material development and reap substantial benefits to the bottom line while improving global health and the environment.

Author Biographies

Mark Rossi, PhD, is the research director at Clean Production Action and co-chair of Health Care Without Harm's Safer Materials Workgroup. He is also a research fellow at the Lowell Center for Sustainable Production at the University of Massachusetts Lowell. The purpose of Rossi's work is to change the course of production away from the dependency on hazardous chemicals to alternatives that are healthy for humans and the environment. Currently he is developing tools for identifying safer chemicals and materials. Rossi's work on safer materials began in the 1980s when he performed life-cycle assessments on plas-

tics for Tellus Institute. He earned his doctorate in environmental policy from MIT, where he focused on green technology development and diffusion.

Tom Lent is technical policy director for the Healthy Building Network, a national network of design professionals, environmental health specialists, and activists working together to advance the use of ecologically superior building materials that are safer throughout their life cycle. Lent helped develop the Green Guidelines for Healthcare Construction (GGHC) as one of the coordinators on the GGHC Steering Committee and serves on the LEED for Healthcare Committee. He has consulted on the development of a variety of other model green building projects and corporate and governmental construction guidelines with the City of San Francisco, Kaiser Permanente, and others around the country with an emphasis on materials and health issues. Lent was honored in 2004 with Environmental Award for Outstanding Achievement by Region 9 of the US Environmental Protection Agency for his work to bring health concerns into green buildings.

Notes

1. US Department of Health & Human Services (USHHS). 2005. Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group. "National Health Expenditure Data, Table 2—National Health Expenditures Aggregate Amounts and Average Annual Percent Change by Type of Expenditure: Selected Calendar Years 1960-2004*,"* http://www.cms.hhs.gov/NationalHealthExpendData/downloads/tables.pdf. *Structures and equipment* includes the value of both new construction and new medical equipment," accessed July 7, 2006.

2. Geiser, K. 2001. *Materials Matter: Toward a Sustainable Materials Policy*. Cambridge, MA: The MIT Press.

3. US Census Bureau. 2006. "Manufacturing, Mining, and Construction Statistics, Construction Spending," May, http://www.census.gov/const/C30/total.pdf.

4. Haughey, J. 2006. "Healthcare Spending Grows Faster in 2006–07," *Building Design & Construction News*, April 1, http://www.bdcnetwork.com/article/CA6323272.html.

5. Information for this section on HUMC is from: Miles Z. Epstein, "A Conversation with Deirdre Imus: A Champion of Children's Health," *Commerce Magazine*, Commerce and Industry Association of New Jersey, April 2005, http://www.cianj.org/magazines/uploads/242678.pdf; and an interview by Tom Lent with Suzen Heeley, director of design and construction, Hackensack University Medical Center, June 15, 2006.

6. Boulder Community Hospital (Colorado), The Patrick H. Dollard Discovery Health Center (New York), and Richard J. Lacks, Sr., Cancer Center (Michigan).

7. See US Green Building Council, Leadership in Energy and Environmental Design (LEED), www.usgbc.org.

8. See *Green Guide for Health Care*, www.gghc.org.

9. For a summary of the relationship between PVC and dioxin, see Health Care Without Harm, "Dioxin, PVC, and Health Care Institutions," October 16, 2002, http://www.noharm.org/library/docs/Going_Green_3-1_Dioxin_PVC_and_Health_Care.pdf.

10. For a summary of the life-cycle hazards of PVC see: Health Care Without Harm, "Why Health Care Is Moving Away from the Hazardous Plastic: Polyvinyl Chloride (PVC)," April 6, 2006, http://www.noharm.org/details.cfm?ID=1277&type=document. For the patient populations vulnerable to DEHP exposure see US Food and Drug Administration, "Public Health Notification: PVC Devices Containing the Plasticizer DEHP," 2002.

11. See *Green Guide for Health Care*, www.gghc.org.

12. See Green Building Council Australia, http://www.gbcaus.org/gbc.asp?sectionid=88&docid=952.

13. See BuildingGreen.com, http://www.buildinggreen.com/.

[14] By materials we mean the basic matter—wood, plastics, metals, paper, minerals, ceramics, cotton, wool, etc.—from which physical products (such as flooring, IV bags, roof coverings, oxygen masks, computers) are made. Note that all materials are comprised of chemicals—chemicals and their atoms are the building blocks of materials. Some materials—such as plastics—are manufactured directly from chemicals synthesized by humans. Other materials—such as wood—consist of chemicals synthesized into unique combinations by nature.

[15] US Green Building Council, Leadership in Energy and Environmental Design (LEED), www.usgbc.org.

[16] See *Green Guide for Health Care*, www.gghc.org.

[17] The text of the Stockholm Convention can be found at http://www.pops.int.

[18] Ibid.

[19] The POPs list includes twelve chemicals. The majority of these chemicals are pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene (also an industrial chemical and industrial byproduct), mirex, and toxaphene. Only hexachlorobenzene and polychlorinated biphenyls (PCBs) are industrial chemicals—manufactured for use in products that are not pesticides. The remaining two chemicals—dioxins and furans—are unintended byproducts of industrial activity.

[20] Any building material can be associated with dioxin releases across its life cycle due to diesel-fuel combustion (for transportation) and coal combustion (power generation) in the manufacturing process. These dioxin releases are not uniquely nor intrinsically related to the material itself. Action to reduce these releases must happen by changing the transportation and power sectors—not the topic of this paper. Other building materials that the US EPA has indicated may have significant direct dioxin releases include: aluminum, copper, and lead smelting (recycling) operations and iron (from sintering operations). Dioxin releases from copper recycling are dropping dramatically as chlorine sources, particularly PVC wire sheathing, are removed from the recycling stream. Lead is already deselected due to criterion 2. Aluminum and iron operations require more analysis to determine the nature of the dioxin formation and whether these operations can be cleaned up to remove chlorine-based contaminants to bring dioxin releases down or whether material avoidance is warranted.

[21] US Environmental Protection Agency. 2005. "The Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States: The Year 2000 Update," External Review Draft, published March 2005, http://www.epa.gov/ncea/pdfs/dioxin/2k-update/.

[22] Ibid.

[23] See, Health Care Without Harm, "The Weight of the Evidence on DEHP: Exposures are a Cause for Concern, Especially During Medical Care," April 6, 2006, http://www.noharm.org/details.cfm?ID=693&type=document.

[24] It should be noted that recycling can sometimes result in higher net energy impacts than virgin materials due to transportation if the materials need to be shipped long distances to centralized plants for recycling. In some cases, it still makes sense to purchase recycled content materials despite high transportation energy costs for a period of time to stimulate investment in the infrastructure to recycle materials locally, eventually reducing impacts for the long haul.

[25] Organic chemicals contain carbon. Chemicals manufactured from fossil fuels and living matter contain carbon—making organic chemicals a significant segment of all chemical production.

[26] Other chlorinated plastics used in construction that also trigger this criterion include: chlorinated polyethylene (CPE), chlorinated polyvinyl chloride (CPVC), chlorosulfonated polyethylene (CSPE), and polychloroprene (chloroprene rubber, also brand name Neoprene). PVC is targeted for priority action because it is far and away the largest end use for chlorine and, hence, the most significant dioxin contributor among plastics. The PVC manufacturing process is the only plastic thus far quantified in the EPA's dioxin assessment. Other chlorine-based plastics, however, are likely dioxin sources and would be placed in the same column as PVC on the plastics spectrum.

[27] For more information on PVC, refer to Health Care Without Harm's fact sheet "Why Health Care Is Moving Away from the Hazardous Plastic Polyvinyl Chloride (PVC)," http://www.noharm.org/details.cfm?ID=1277&type=document and the Healthy Building Network's fact sheet "PVC in Buildings: Hazards and Alternatives," http://www.healthybuilding.net/pvc/facts.html.

28 Specifically, high-impact polystyrene.

29 For more information on HFRs, refer to Health Care Without Harm's fact sheet, "What Health Care Purchasers Can Do to Reduce Flame Retardants," http://www.noharm.org/details.cfm?type=document&id=1108.

30 See, for example, Japan, Ministry of Environment, "Endocrine Disrupting Chemicals Database, Table of Chemicals Suspected of Having Endocrine Disrupting Effects," 1998, http://w-edcdb.nies.go.jp/HPEF/sp_Table3.html, accessed 7/24/06; and BKH Consulting (prepared for the European Commission DG ENV), Toward the establishment of a priority list of substances for further evaluation of their role in endocrine disruption—preparation of a candidate list of substances as a basis for priority setting (M0355008/1786Q/10/11/00), June 2000, http://ec.europa.eu/environment/docum/pdf/bkh_main.pdf, accessed 7/24/06.

31 For example, see European Communities, CONSLEG: 1976L0769—16/03/2004, Council Directive of 27 July 1976 on the approximation of the laws, regulations, and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (76/769/EEC) (OJ L 262, 27.9.1976, p. 201), Consolidated Text produced by the CONSLEG system of the Office for Official Publications of the European Communities, 16 March 2004, http://ec.europa.eu/enterprise/chemicals/legislation/markrestr/consolid_1976L0769_en.pdf.

32 Carbon black is an International Agency for Cancer Research (IARC) 2B carcinogen, meaning it is possibly carcinogenic to humans, as well as a California Proposition 65 listed carcinogen (State of California, Environmental Protection Agency, Office of Environmental Health Hazard Assessment, "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity," June 9, 2006, http://www.oehha.ca.gov/prop65/prop65_list/files/060906p65single.pdf).

33 For example, see US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, "Draft Toxicological Profile for Lead," 1999, http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf.

34 U.S. Department of Health and Human Services, 2003. Public Health Service, Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Tin and Tin Compounds," http://www.atsdr.cdc.gov/toxprofiles/tp55.pdf.

35 Note that PFOS and PFOA or C8 are not necessarily ingredients in the final treatment product, but are used in manufacture and can be breakdown products—that is, the treatment can breakdown into PFOA or PFOS in the environment.

36 US Environmental Protection Agency. 2005. Office of Pollution Prevention and Toxics, Risk Assessment Division. "Draft Risk Assessment of the Potential Human Health Effects Associated with Exposure to Perfluorooctanoic Acid and its Salts," January 4, http://www.epa.gov/opptintr/pfoa/pubs/pfoarisk.pdf.

37 For example, see European Communities, CONSLEG: 1976L0769—16/03/2004, Council Directive of 27 July 1976 on the approximation of the laws, regulations, and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (76/769/EEC) (OJ L 262, 27.9.1976, p. 201), Consolidated Text produced by the CONSLEG system of the Office for Official Publications of the European Communities, 16 March 2004, http://ec.europa.eu/enterprise/chemicals/legislation/markrestr/consolid_1976L0769_en.pdf, and State of California, Environmental Protection Agency, Office of Environmental Health Hazard Assessment, "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity," June 9, 2006, http://www.oehha.ca.gov/prop65/prop65_list/files/060906p65single.pdf.

38 Forest Stewardship Council, http://www.fsc.org.

39 Land limits and competition for food and fuel mean that we cannot expand plastic production from plant matter without limit.

40 The commodity plastics are those plastics produced and consumed in the greatest quantities: PET, polypropylene, polyethylene, polystyrene, and PVC.

41 See Integrated Waste Management Board, 2003. "Plastics White Paper: Optimizing Plastics Use, Recycling, and Disposal in California," Sacramento; and Clean Washington Center (CWC), 1997, "Best Practices in PET Recycling: Contamination Issues," http://www.cwc.org/pet_bp/3-04-01.pdf.

[42] Acrylonitrile is listed by the International Agency for Research on Cancer (IARC) as a Group 2A carcinogen, meaning it is probably carcinogenic to humans.

[43] 1,3 Butadiene is listed by IARC as a Group 2A carcinogen, meaning it is probably carcinogenic to humans.

[44] European Communities, CONSLEG: 1976L0769—16/03/2004, Council Directive of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (76/769/EEC) (OJ L 262, 27.9.1976, p. 201), Consolidated Text produced by the CONSLEG system of the Office for Official Publications of the European Communities, 16 March 2004, http://ec.europa.eu/enterprise/chemicals/legislation/markrestr/consolid_1976L0769_en.pdf.

[45] California Environmental Protection Agency. 2006. Office of Environmental Health Hazard Assessment, "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity," June 9, http://www.oehha.ca.gov/prop65/prop65_list/files/060906p65single.pdf, accessed 7/24/06.

[46] Styrene monomer is listed by IARC as a Group 2B carcinogen, meaning it is possibly carcinogenic to humans.

[47] Vinyl acetate is listed by IARC as a Group 2B carcinogen, meaning it is possibly carcinogenic to humans.

[48] See, for example, Japan, Ministry of Environment, "Endocrine Disrupting Chemicals Database, Table of Chemicals Suspected of Having Endocrine Disrupting Effects," 1998, http://w-edcdb.nies.go.jp/HPEF/sp_Table3.html, accessed 7/24/06; and BKH Consulting (prepared for the European Commission DG ENV), Toward the establishment of a priority list of substances for further evaluation of their role in endocrine disruption—preparation of a candidate list of substances as a basis for priority setting (M0355008/1786Q/10/11/00), June 2000, http://ec.europa.eu/environment/docum/pdf/bkh_main.pdf, accessed 7/24/06.

[49] Formaldehyde is listed by IARC as a Group1 carcinogen, meaning it is carcinogenic to humans.

[50] Silica dust is listed by IARC as a Group 1 carcinogen, meaning it is carcinogenic to humans.

[51] State of California, Environmental Protection Agency, Office of Environmental Health Hazard Assessment, "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity," June 9, 2006, http://www.oehha.ca.gov/prop65/prop65_list/files/060906p65single.pdf, accessed 7/24/06.

[52] National Toxicology Program, Center for the Evaluation of Risks to Human Reproduction, U.S. Department of Health and Human Services. "NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Ethylene Glycol," NIH Publication No. 04-4481. 2004 (Research Triangle Park: NTP).

[53] For more discussion on VOC certification programs and materials screening see the Healthy Building Network's fact sheet "Screening the Toxics out of Building Materials," http://www.healthybuilding.net/pdf/ Healthy_Building_Material_Resources.pdf.

[54] See Greiner, T., Rossi, M., Thorpe, B. Kerr, B. *Healthy Business Strategies*, 2006. (Spring Brook, NY: Clean Production Action), www.cleanproductionaction.org.

[55] United States Government Accountability Office. 2005. *Chemical Regulation: Options Exist to Improve EPA's Ability to Assess Health Risks and Manage Its Chemical Review Program* (GAO-05-458), June, http://www.gao.gov/new.items/d05458.pdf, accessed 7/24/06.

Appendix 1: Greening the Cleaning Must Not List

Greening the Cleaning is a cleaning protocol developed at the Deirdre Imus Environmental Center for Pediatric Oncology at Hackensack University Medical Center. The protocol guides users to eliminate to the greatest extent possible all cleaning agents containing hazardous ingredients and replace them with environmentally friendly products that utilize natural or naturally derived ingredients.

The Greening the Cleaning protocol uses the following guidelines—which were adapted from the US Department of Interior's "Guidance and Training on Greening Your Janitorial Business: Environmentally Preferable Attributes of Chemical Cleaners" and other standards—for formulating cleaning and related products.

They

Must not contain carcinogens, mutagens, or teratogens.

Must not contain any ozone-depleting compounds, greenhouse gases, or substances that contribute to smog.

Must not be corrosive or irritating to the skin or eyes.

Must not be delivered in aerosol cans.

Must not contain petrochemical-derived fragrances.

Must not contain toxic dyes.

Must not contain arsenic, lead, cadmium, cobalt, chromium, mercury, nickel, or selenium.

Must not contain hazardous wastes.

Must not contain petroleum distillates over .1 percent.

Must not be combustible.

Must not contain chlorinated solvents.

Must not contain persistent or bio-accumulative substances.

Volatile organic compound (VOC) levels must meet or be less volatile than the California Code of Regulations maximum allowable VOC level for the various categories.

Must be readily biodegradable.

Must be biobased.

Must be dispensed through automatic systems to reduce employee contact.

Must have a pH level between 4 and 9.

More information on Greening the Cleaning and the Deirdre Imus Environmental Center for Pediatric Oncology at Hackensack University Medical Center can be found at http://www.dienviro.com. Reprinted with permission.

Appendix 2: Green Chemistry

Twelve Principles of Green Chemistry

1. Prevent waste: Design chemical syntheses to prevent waste, leaving no waste to treat or clean up.

2. Design safer chemicals and products: Design chemical products to be fully effective, yet have little or no toxicity.

3. Design less hazardous chemical syntheses: Design syntheses to use and generate substances with little or no toxicity to humans and the environment.

4. Use renewable feedstocks: Use raw materials and feedstocks that are renewable rather than depleting. Renewable feedstocks are often made from agricultural products or are the wastes of other processes; depleting feedstocks are made from fossil fuels (petroleum, natural gas, or coal) or are mined.

5. Use catalysts, not stoichiometric reagents: Minimize waste by using catalytic reactions. Catalysts are used in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and work only once.

6. Avoid chemical derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.

7. Maximize atom economy: Design syntheses so that the final product contains the maximum proportion of the starting materials. There should be few, if any, wasted atoms.

8. Use safer solvents and reaction conditions: Avoid using solvents, separation agents, or other auxiliary chemicals. If these chemicals are necessary, use innocuous chemicals.

9. Increase energy efficiency: Run chemical reactions at ambient temperature and pressure whenever possible.

10. Design chemicals and products to degrade after use: Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.

11. Analyze in real time to prevent pollution: Include in-process real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.

12. Minimize the potential for accidents: Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and releases to the environment.

Source: Anastas, P. T., and J.C. Warner. 1998. Green Chemistry Theory and Practice *New York: Oxford University Press. Also see Green Chemistry Institute Web site at www.greenchemistryinstitute.org.*

Appendix 3: Stockholm Convention Persistent Organic Pollutants (POPs); Persistent, Bioaccumulative, and Toxic (PBT); and Very Persistent and Very Bioaccumulative (vPvB) Lists

| CAS | Chemical | POPs[1] | PBTs | | | vPvBs |
			EU[2]	US EPA Priority PBTs[3]	WA[4]	EU[2]
87-61-6	1,2,3-trichlorobenzene		1			
120-82-1	1,2,4-trichlorobenzene		1			
84852-15-3	4-nonylphenol (branched)				1	
309-00-2	Aldrin	1		1	1	
120-12-7	Anthracene		1			
7440-43-9	Cadmium				1	
57-74-9	Chlordane	1		1	1	
3734-48-3	Chlordecone (Kepone)				1	
50-29-3	Dichlorodiphenyltrichloroethane (DDT)	1	1	1	1	
60-57-1	Dieldrin	1		1	1	
68515-49-1 and 26761-40-0	Di-isodecyl phthalate (DIDP)				1	
84-75-3	Di-n-hexyl phthalate (DnHP)				1	
several	Dioxins	1		1	1	
90640-86-1	Distillates (coal tar), heavy oils		1			
115-29-7	Endosulfan		1			
72-20-8	Endrin	1			1	
several	Furans	1		1	1	
76-44-8	Heptachlor	1			1	
1024-57-3	Heptachlor epoxide				1	
36355-01-8	Hexabromobiphenyl				1	
25637-99-4	Hexabromocyclododecane				1	
118-74-1	Hexachlorobenzene	1	1	1	1	1
87-68-3	Hexachlorobutadiene				1	
7439-92-1	Lead			1	1	
58-89-9	Lindane		1			
7439-97-6	Mercury			1	1	

| CAS | Chemical | POPs[1] | PBTs | | | vPvBs |
			EU[2]	US EPA Priority PBTs[3]	WA[4]	EU[2]
2385-85-5	Mirex	1		1	1	
1836-75-5	Nitrofen		1			
25154-52-3	Nonylphenol				1	
	Octachlorostyrene					
several	PAHs				1	
56-49-5	PAHs - 3-Methyl chlolanthrene				1	
218-01-9	PAHs - Benzo(a)phenanthrene (Chrysene)				1	
50-32-8	PAHs - Benzo(a)pyrene			1	1	
205-99-2	PAHs - Benzo(b)fluoranthene				1	
191-24-2	PAHs - Benzo(g,h,i)perylene				1	
205-82-3	PAHs - Benzo(j)fluoranthene				1	
207-08-9	PAHs - Benzo(k)fluoranthene				1	
189-55-9	PAHs - Benzo(r,s,t)pentaphene				1	
192-65-4	PAHs - Dibenzo (a,e)pyrene				1	
189-64-4	PAHs - Dibenzo (a,h)pyrene				1	
226-36-8	PAHs - Dibenzo(a,h)acridine				1	
53-70-3	PAHs - Dibenzo(a,h)anthracene				1	
224-42-0	PAHs - Dibenzo(a,j)acridine				1	
206-44-0	PAHs - Fluoranthene				1	
193-39-5	PAHs - Indeno(1,2,3-cd) pyrene				1	
198-55-0	PAHs - Perylene				1	
194-59-2	PAHs -7H-Dibenzo(c,g)carazole				1	
13654-09-6	PBDE - Decabromodiphenyl ether				1	
32536-52-0	PBDE - Octabromodiphenyl ether		1		1	
32534-81-9	PBDE - Pentabromodiphenyl ether				1	
1336-36-3	PCBs	1		1	1	
608-93-5	Pentachlorobenzene				1	
133-49-3	pentachlorobenzenethiol		1			1
1763-32-1	Perfluorooctane sulfonates (PFOS) Acid				1	
29081-56-9	Perfluorooctane sulfonates (PFOS) Ammonium salt			1		

| CAS | Chemical | POPs[1] | PBTs | | | vPvBs |
			EU[2]	US EPA Priority PBTs[3]	WA[4]	EU[2]
70225-14-8	Perfluorooctane sulfonates (PFOS) Diethanolamine salt				1	
29457-72-5	Perfluorooctane sulfonates (PFOS) lithium salt				1	
2795-39-3	Perfluorooctane sulfonates (PFOS) Potassium salt				1	
32241-08-0	Polychlorinated naphthalenes - Heptachloronaphthalene				1	
1335-87-1	Polychlorinated naphthalenes - Hexachloronaphthalene				1	
1321-64-8	Polychlorinated naphthalenes - Pentachloronaphthalene				1	
1335-88-2	Polychlorinated naphthalenes - Tetrachloronaphthalene				1	
1321-65-9	Polychlorinated naphthalenes - Trichloronaphthalene				1	
92061-94-4	Residues (coal tar), pitch distn.		1			
85535-84-8	Short-chain chlorinated paraffins				1	
79-94-7	Tetrabromobisphenol A				1	
95-94-3	Tetrachlorobenzene, 1,2,4,5-				1	
75-74-1	Tetramethyllead		1			1
8001-35-2	Toxaphene	1		1	1	
56-35-9	Tributyltin oxide (TBTO)		1			

[1] Source: Stockholm Convention on Persistent Organic Pollutants, http://www.pops.int/documents/convtext/convtext_en.pdf.

[2] Source: European Chemicals Bureau, European Union, Status report on PBTs and vPvBs for New and Existing substances, http://www.defra.gov.uk/environment/chemicals/achs/060606/achs0614d.pdf

[3] Source: US EPA, Priority PBTs, http://www.epa.gov/pbt/pubs/cheminfo.htm

[4] Source: Washington State PBT list, http://www.ecy.wa.gov/programs/eap/pbt/pbtfaq.html

Preventative Medicine for the Environment: Developing and Implementing Environmental Programs that Work

Laura Brannen

Healthcare is the largest single industrial sector in the US economy—$2 trillion dollars annually. It's 16 percent of the US economy and estimated to grow to 20 percent by 2015. There are just fewer than 6,000 hospitals and more than 500,000 clinics, long-term care, and other types of facilities, most operating seven days a week, twenty-four hours per day. The global engine that drives this medical industrial complex contributes to a wide variety of environmental and related health concerns. No other healthcare system in the world has higher costs per patient day. While some might suggest that's a reflection of the highest quality care in the world, it's also an indicator of unparalleled resource consumption that include impacts from the design, manufacture, delivery, use, and disposal of materials used in the delivery of care that may very well be jeopardizing the health of the planet and threatening the availability of clean air, water, and ecosystems.

Healthcare facilities alone generate a tremendous variety and quantity of waste—at least 2 million tons of waste per year—that may represent real occupational and environmental health threats. It's the fourth largest consumer of energy, spending $6.5 billion on energy costs alone and accounting for 11 percent of all commercial energy use. Water consumption and discharge to public sewer systems are excessive. Healthcare institutions are consistently within the top ten water users in their communities. Waste water contains toxic lab and cleaning chemicals and pharmaceutical compounds, many of which are not broken down in sewage treatment plants and are disposed of in landfills, result in sewage sludge applied to farmland, or are released in rivers and streams.

The delivery of high-quality healthcare has imposed a high environmental cost that, until the mid-1990s, was largely ignored by the healthcare sector and environmental regulators. Regulators focused on other industry sectors while healthcare appeared immune to scrutiny due to the *higher mission* of providing healthcare. Further, the healthcare "sector" has never been perceived by the community as an *industry* at all, and certainly not one that is polluting. The vision of spewing smokestacks or polluted waterways is *not* associated with the local hospital.

However, it was only ten years ago that 6,200 medical waste incinerators were responsible for healthcare being identified as the fourth largest source of mercury emissions and the second leading source of dioxin emissions, along with a host of other concerns associated with incineration such as acid rain and heavy metal and particulate emissions linked to asthma and other health ailments. Today there are fewer than 100 medical waste incinerators, but thousands of municipal waste incinerators continue to operate. So while healthcare specifically is no longer among the largest identifiable sources, many healthcare institutions send their waste to incinerators that continue to contribute to environmental and human health threats.

In the late 1990s, the US Environmental Protection Agency (EPA) targeted healthcare for environmental compliance inspections—what they found was startling.

Helpful Websites

American Institute of Architects:
http://www.aia.org

Green Guide for Health Care:
http://www.gghc.org/

Hospitals for a Healthy Environment:
http://www.h2e-online.org

US Environmental Protection Agency, Energy Star: http://www.energystar.gov

Compared to general industry where 1 in 30 inspections resulted in compliance violations and fines, in healthcare, 1 in 2 facilities were found to be out of compliance with basic environmental regulations. That means that, on average, 50 percent of the nation's hospitals may be inappropriately managing their hazardous chemicals—not identifying and/or disposing of them properly, not keeping proper records, violations in managing underground storage tanks—among a long list of specific infractions.

The problems are not insurmountable, and the solutions can be cost-effective and practical. There are many examples of environmental leadership in facilities that have implemented comprehensive and sustainable programs with full support from administration and staff. While there are certain programs that cost money (e.g., recycling batteries and fluorescent bulbs or purchasing a more environmentally preferable product), there are more examples of how pollution prevention programs are cost-effective and relatively easy to implement.

The goal of this paper is to suggest steps in moving from the theoretical aspects of why healthcare facilities should adopt green principles to how to do it. This paper has three primary objectives: to provide an overview of the planning and implementation of a comprehensive environmental program including basic waste management considerations and cost-benefit analysis, to suggest the necessary conditions that must be adopted to institutionalize sustainable programs and, finally, to provide specific examples of practical and cost-effective programs to suggest the broad applicability of these programs across the entire sector.

Hospitals for a Healthy Environment

Hospitals for a Healthy Environment (H2E) was launched in 1998 by agreement between the EPA, American Hospital Association (AHA), American Nurses Association, and Healthcare Without Harm (HCWH) as a result of the damning reports identifying healthcare as leading sources of toxic chemical emissions to the environment—mercury and dioxin, specifically, but there are others. The agreement set forth goals to create a program to advance pollution prevention in the nation's hospitals creating a national movement for environmental sustainability in healthcare.

H2E is based on a vision of a healthy healthcare system—a system in which an environmentally aware and engaged healthcare community is dedicated to the health of patients, workers, their communities, and the global environment. H2E's work intends to create operational systems where patients and staff interact in a healing environment that embraces safer building products, clean air, reduced toxins, safe working practices, energy and water efficiency, environmental education, and a commitment to public health demonstrated through specific, practical waste-volume and toxicity-reduction programs. H2E works to make that system a reality by assisting the healthcare sector to accomplish the tasks that will institutionalize environmental stewardship in our nation's hospitals. Throughout the paper, there are references to H2E award-winning facilities that have implemented a variety of programs consistent with the vision of a greener healthcare sector.

Healthcare waste

Today, medical waste treatment and disposal is a multibillion dollar industry, yet most hospitals are not aware of how much waste they generate or how much they spend annually on disposal, not to mention

the environmental impacts created in the process. Scoping the opportunity to improve performance and reduce management and disposal costs begins with a basic understanding of the waste streams and the relative environmental impacts and disposal costs of each, which differ significantly. Regulated medical waste (RMW), or red bagged waste, costs about ten times more to treat and dispose of than does regular trash or solid waste. Hazardous chemical waste, while the smallest by volume, less than 1 percent of the total waste, can be 500 times more expensive than solid waste.

A highly regulated environment

There is a dizzying array of regulations that may add management or operational costs. To name a few, the Occupational Safety and Health Administration (OSHA) Hazard Communications Plan outlines how facilities "use" hazardous chemicals in the workplace and how those hazards must be communicated to all staff. OSHA's Bloodborne Pathogens Standard outlines how facilities must handle potentially infectious materials. EPA's Resource Conservation and Recovery Act (RCRA) regulations govern how to manage hazardous chemical waste, and the Department of Transportation (DOT) regulations outline how it can be shipped and transported. Health Insurance Portability and Accountability Act (HIPAA) regulations set guidelines for the management of confidential materials.

These costs, however, are the expenses of doing business in any institution that uses chemicals or other potential hazardous materials that may harm workers (OSHA) or the environment (RCRA). They are not optional. Pollution prevention (P2), on the other hand, is seen by many as being optional. That is a mistake. H2E subscribes to helping hospitals to *first* be in compliance—it's the law. But also, as community health leaders, it's imperative for hospitals to go *beyond* compliance. P2, or beyond compliance programs, means that hospitals minimize or eliminate the use of hazardous chemicals in the first place, thereby reducing the regulatory liabilities and costs.

Data collection

Compiling environmental and waste data provides powerful benchmark data to help prioritize environmental efforts based upon waste category and cost analysis. For example, if a facility doesn't know how much RMW is generated as a percentage of the total waste and doesn't know

> You can't *manage* what you don't know you have...

the cost, there are more than likely big opportunities to reduce the amount to the target rate and significantly reduce costs.

Table 1 describes the four basic waste streams, their typical disposal cost per ton, and the target percentage of total waste potential assuming best practices. If a facility is generating any more than a target of 8 percent to 15 percent of total waste in red bags, then it is spending ten times more per pound for every pound over the target generation rate.

Few facilities understand, or have compiled, all the costs associated with their waste management program, including a long list of *hidden* fees: hauling fees, tipping fees, processing fees, container rental fees, etc. After including all these costs and surcharges, is the cost per ton for a particular waste stream above the regional or national benchmark? Are there opportunities to renegotiate contracts because the data has identified glaring inefficiencies? Is the facility using the right container size and maximizing how often a waste container is pulled? Data provides the answers to these questions, and the findings are impressive.

Wheaton Franciscan Health System, a seventeen-hospital system in the Wisconsin area, launched a data collection effort in 2005 and, in the first year, estimated a systemwide savings of $600,000. Metro Health in Grand Rapids, Michigan, also launched a similar effort but as a single hospital and too realized about $40,000 in potential cost savings after one year.

Table 1: Basic Waste Streams

Waste Type	Definition	Target as Percentage of Total Waste	General Disposal Methods	Typical Cost for Disposal
Waste reduction programs (recycling, reuse, source reduction)	Reducing: using less product in the first place, thereby generating less waste Reusing: materials exchanges, using a product until it is no longer usable Recycling: Refuse which is reprocessed into new products	20-40%	Most recyclables are shipped off site for processing and subsequent reuse.	Wide range • Cardboard and paper should generate revenue. • Glass and plastics typically cost. • Objective: total cost of program should beat landfill costs (i.e., avoided landfill costs pay for the program)
Infectious waste	Solid or liquid wastes that have a significant potential for transmitting infection or require special handling due to state regulations and some federal regulations	8-15%	• Treatment, such as autoclave then landfill • 10% of total RMW is path waste requiring incineration	Off-site treatment: $0.26 - $0.38 per lb; $500 – $800 per ton
Hazardous chemical waste	Solid or liquid waste containing flammable, toxic, corrosive, or reactive chemicals. Also includes a special hazards category (i.e., radioactive) and listed wastes.	<1%%	Managed according to OSHA, EPA, and local and state regulations and shipped off site for proper disposal.	Up to $5000 per ton depending upon material
General solid waste	Solid wastes that are not hazardous, infectious, or recyclable; may include some food wastes, trash, and construction and demolition waste (although those too can be recycled)	50%	Landfill or municipal solid waste incinerator	Wide range depending upon area of country: $0.02 - $.50 per lb.; $33-$100 per ton

Putting together the fundamentals of a comprehensive environmental program

Organizational infrastructure and leadership

Until the recent advent of the greening of healthcare, few facilities understood their waste management infrastructure. Environmental programs have typically been highly decentralized across many departments: environmental services (housekeeping), facilities/engineering, safety and security, purchasing. Or maybe these programs are virtually nonexistent, decentralized or not, resulting in a lack of leadership and focus.

Facilities must create an organizational chart of what department or staff person has authority and responsibility for each waste stream in Table 1, including regulatory oversight, general operations and billing, and new employee and annual training requirements. They then should *designate a leader*. For facilities that have begun to implement comprehensive programs, centralization of these programs and having someone in charge is a natural progression. An environmental programs coordinator is referred to throughout the rest of the document and is assumed to be a staff person internally coordinating and implementing a variety of environmental programs.

Waste segregation and collection infrastructure

The basics of a waste management program means providing the proper containers—color coded, properly labeled, and strategically placed for all waste streams, increasing the likelihood that the right materials will go into them. So, for example, red bags should never be placed under handwashing sinks where no infectious waste is generated while handwashing. Recycling bins should always be placed next to copiers where there is 100 percent likelihood of paper generation. Beverage container recycling bins should always be found in conference rooms where a lot of catering takes place or in patient kitchens where these containers are also generated.

Training, education, and communications

On the first day of employment, new staff members should understand their responsibilities in participating in an institution's environmental programs. In fact, participation according to policy (then, of course, a facility needs policies), should be part of the official job description. Particularly where occupational and patient safety is concerned, it is every staff member's responsibility to use materials responsibly and manage the waste that he or she generates appropriately. Training doesn't stop at new employee orientation, but is a continuous program of improvement and education.

Public relations opportunities should not be overlooked. Not only should staff know about the commitment to the environment and community health, but also patients and community members should be informed of progress as well through articles in internal newsletters, community newspapers, and a web page dedicated to the facility's environmental programs.

Regulated Medical Waste Reduction

Foote Health System in Jackson, Mississippi, reduced its RMW from 180 to 105 tons over two years, saving $44,100 a year.

Source: H2E 2005 awards brochure

Green Memorial Hospital vs. Brown Medical Center

Typical reasons given for lack of broader participation implementing environmental programs include no time, no space, and no money.

Let's first address the *no money* barrier by a simple waste management comparison of two hypothetical 425-bed hospitals that both generate almost 2,400 tons of waste annually. In summary, Green Memorial Hospital has a progressive and comprehensive waste management program that includes an innovative recycling program where 38 percent or 900 tons of its waste is recycled, saving $54,000 in avoided landfill costs. Green has an ongoing RMW management program and manages a consistent generation rate of 10 percent. Green spends about $245,000 per year on waste disposal.

On the other hand, *Brown Medical Center* doesn't have a waste segregation or recycling program. The 900 tons of materials that Green Memorial is recycling is being disposed of in a combination of expensive regulated medical waste and solid waste. It spends $596,000 annually on waste disposal. That's a difference of $351,000!

Hospitals can't afford *not* to pay attention to the backdoor. The hospitals above are hypothetical, but hundreds of H2E partner hospitals have won recognition exemplifying the many opportunities to save resources through improved waste management and environmental programs coordination.

As this comparison illustrates, it's shortsighted to not invest in the resources to institutionalize programs that will ultimately pay for themselves. The commitment requires a shift in mindset and leadership to make the investment. Savings must be tracked on an annual basis and reported to the institution's leadership. This step cannot be underestimated and is discussed further in this paper.
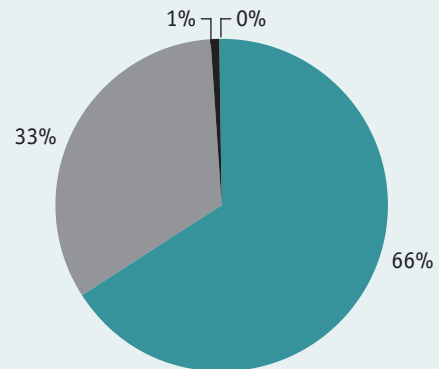
Figure 1

Green Memorial Hospital
Total Waste Disposal Costs = $245,000
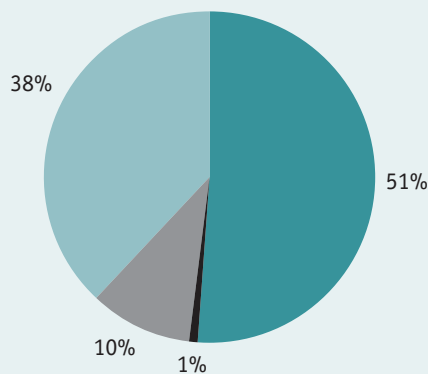
- Solid waste: ~ 1200 tons = $72,000
- RMW: ~ 225 tons = $135,000
- Hazardous chemical waste: ~ 19 tons = $38,000
- Recycling: Assumes breakeven costs. Avoided landfill cost of $54,000!

Brown Medical Center
Total Waste Disposal Costs = $596,000

- Solid waste: ~ 1550 tons = $93,000
- RMW: ~ 775 tons = $465,000
- Hazardous chemical waste: ~ 19 tons = $38,000
- Recycling: no recycling program

Other barriers

No time

Today, particularly in smaller facilities, one director may have responsibility for all support services—housekeeping, facilities, linen, dining, safety and security, purchasing, in addition to construction, emergency preparedness, and contingency planning. Without the investment in additional resources to realize the potential savings, asking existing staff to add P2 projects to already overburdened plates is indeed overwhelming. When working with hospitals to encourage them to make the investment, it's important to understand the reality of *no time*

considerations. This barrier may slow down the implementation, but there is enough data available to begin to make a cost-benefit argument to investing the necessary resources, even in small steps, to make the time that is required to implement sustainable programs.

No space

In older facilities, not having enough space is also a reality. Nurses' stations, dirty utility rooms, kitchens, meeting rooms, office space, trash docks—none of these areas have space for multiple recycling bins. Theoretically, the same amount of material coming into the facility is leaving the facility, but compare dock and handling space allocated for receiving functions to space for trash docks. Until recently, design considerations did not include space for multiple source-segregated materials. The *American Institute of Architects Guidelines for Design and Construction of Hospitals and Health Care Facilities* released earlier this year specifies design and space requirements for waste handling, storage, and treatment. This is a fundamental breakthrough that allocates appropriate space and will significantly improve the ease in which these programs can operate.

But for most facilities that have older buildings and are short of space, many have come up with some innovative ways to overcome this barrier.

Commingling materials

Instead of categories and containers for white paper, mixed (colored) paper, cardboard, newspaper, confidential paper, etc., all paper is combined into one category and assumed to have the potential to contain private information and treated with universal privacy precautions. Of course, that means that magazines and newspapers are treated as confidential, but by simplifying the system, facilities are (1) able to replace trash containers with recycling bins, (2) significantly increase compliance with HIPAA, and (3) significantly increase recycling rates. The ability to collect commingled recyclables may depend on a local recycling hauler's ability to collect the materials together, as well as the ability to manage confidential documents securely.

Commingled beverage containers include aluminum cans, plastic soda and water bottles, and glass juice bottles. Few facilities have the space to collect these materials separately. If a facility doesn't have access to a materials recovery facility in the community that can sort recyclables, some healthcare facilities have employed developmentally disabled members of the community to sort recyclables on site. Some space is required for the task, and strong support staff and commitment is necessary. However, commingling beverage containers saves space, increases staff access to recycling them and will, therefore, increase participation and recycling rates.

Collection and storage at the backdoor

Space for box trucks, compactors, and roll-offs (30- to 40-yard containers typically found near the trash dock that store trash, construction, and demolition debris or recyclables for transportation) is very limited. Facilities have placed large containers in the parking lots or knocked holes in walls and used chutes to connect to containers outside. Big balers can be installed that can compact up to 1,000 pounds of cardboard per bale that reduces storage-space requirements. Baled cardboard can also generate revenue. Smaller balers that make "hay-bale" sized bales of up to 100 pounds also reduces storage requirements for tin and aluminum cans, shrink wrap, and plastics by compacting them. When there is an environmental commitment and a financial benefit, there is most often a way to address the no-space barrier, but creativity and commitment are required.

Without a leader, however, the opportunities to develop and implement these or any program is much more limited. The next section suggests creating an infrastructure to institutionalize environmental programs by having a champion or coordinator who can develop and manage programs and garner department and leadership support.

Environmental programs coordinator: Watching the backdoor

The trash dock can tell stories of inefficiencies and lack of systems. One can see where unused surgical supplies are thrown away at the end of a case in the operating room, or where an office move took place, perhaps someone retiring because office supplies, books, file folders, even equipment, are thrown away because there was no place else to put it. An environmental programs coordinator is charged with the task of watching the *backdoor* for opportunities to reduce waste. The following programs are examples of identifying problems at the backdoor and implementing practical solutions and process improvements that can be implemented to address the problems of materials being tossed.

Unopened and unused supplies in the trash

The problem with tossing unused supplies is obvious enough: not only is there an environmental impact of disposal, but also the purchasing cost implications of this inefficiency are staggering. Ironically, healthcare providers are often not aware of the purchase costs of supplies. When a patient is discharged, all the supplies in that patient room are typically summarily tossed. What might an environmental coordinator do?

- Most of the time, staff members throw away materials because they don't know what else to do with them once removed from a supply cart. A disposition policy for patient-care supplies can address three options for material disposition: restocking, donation, disposal/recycling as follows.

- Supplies that should be restocked: Working with the infection control to address patient-safety issues, develop a policy for which type of supplies and in what condition should be restocked. For example, rehab devices that don't fit a patient, such as collars and splits, are obvious items to restock. Unopened supplies whose packaging is not contaminated in any way should always be restocked. Collect data of material that are no longer tossed and extrapolate savings if possible—there is potential to save tens of thousands of dollars in the avoided cost of re-purchasing expensive supplies, and these numbers can help provide documentation to support the environmental coordinator position.

- Supplies that are opened but unused and cannot be re-stocked or used in any way: Create a donation program through a well-established national or international charity. Also consider local charities or organizations including shelters, nonprofit clinics, even farms or animal shel-

ters. A donation program requires a small space to store the surplus—a place to go through the materials before they leave the facility. Establish well-defined policies that outline what is acceptable or not. Work with public affairs to communicate your efforts and successes with donation programs. The program will be more successful if there is broad support from staff and the communities that understand where the materials are going and what positive impacts the programs have created from waste reduction to charitable efforts. (More information on development and implementation of a donation program can be found on the H2E website at www.h2e-online.org/.)

- Supplies that must be thrown away: Some opened supplies cannot be donated or reused. But these supplies are *not* regulated medical waste, they are not contaminated and should be recycled or disposed of in the solid waste. A comprehensive waste management policy should include proper disposal of nonregulated medical waste.

Medical supplies in the operating room

Coordinators can work with operating room (OR) purchasing staff to provide data that would drive changes on how supplies and instruments are utilized in the OR. Start with resource reduction, meaning using less material in the first place. In the OR, can some supplies remain unopened until they are needed? Assess OR pre-packaged case-pack contents to remove items in the pack that are *rarely* used. Next, assess waste minimization opportunities—how are unused items being disposed? Go back to the guidelines for disposition of patient-care items and funnel appropriate items for restocking or donation. Is packing recyclable? If so, create the infrastructure to capture and manage that material.

Disposable vs. reusables

Disposables have been *sold* to facilities based upon a financial analysis of decreased labor that would otherwise be required to wash or launder reusable items. But a life-cycle analysis is rarely done (or repeated after a time) that includes increased purchasing costs of more units, labor costs to stock and transport disposables, and disposal costs. A coordinator's job is to track and report on this reality. For example:

- Re-useable linens and gowns: A "choose reusables" campaign is an effective way to educate staff to reach for a reusable gown or to promote reusable towels and chux (underbed garments that are perfectly reusable). To also ensure that reusable materials are not being thrown away, usage reports combined with watching the backdoor will identify action items to reduce waste.

- Single-use device reprocessing programs: Outsource the re-processing of single-use, disposable items. Facilities across the country have saved up to 30 percent on the purchase of new devices. While further study is necessary to assess the full environmental impact of reprocessing, reprocessing single-use items reduces the use of virgin materials and manufacturing impacts.

Environmentally preferable purchasing

Environmentally preferable purchasing (EPP) is the act of purchasing products/services whose environmental impacts have been considered and found to be less damaging to the environment and human health when compared to competing products/services. Downstream corrections of environmental or occupational health issues are almost always more costly—in terms of dollars, labor, technical complexity, and adverse publicity—than preventing the harm in the first place.

The environmental coordinator can also provide leadership in the selection of environmentally preferable goods and services. A good EPP program can significantly reduce overall impact on the environment; reduce costs with lower purchase prices or changes that eliminate some waste disposal; reduce the need for worker-safety measures and hazardous waste disposal; provide a healthier environment for patients, workers, and employees through reduced exposure to hazardous substances in such products as cleaners, solvents, and paints; and create opportunities for positive publicity and promotion.

Understand recycling and waste markets

The analysis of the Brown and Green facilities assumes a breakeven cost of recycling. Paper and cardboard recycling has the potential to generate revenue, but that will only happen if there is someone responsible who understands recycling markets and holds recycling haulers accountable. Understanding recycling markets will also help prioritize the development of recycling programs within the institution.

HIPAA

The Health Information Portability and Accountability Act plays a role in the cost of paper disposal and recycling. Patient information on paper and other media must ultimately be destroyed to protect privacy. HIPAA does not dictate that materials be shredded, but that it be managed securely. However, misinformation, perceived risk, and document-destruction vendors have collectively created a new and expensive waste stream—confidential shredding—that is often unnecessary. Without a coordinator ensuring efficient and secure processes and connecting the HIPAA program to the recycling program, facilities are spending too much money and not taking advantage of the opportunity to increase paper recycling.

Institutionalizing environmental programs: Creating Green Teams

While having a dedicated environmental coordinator onboard is the most likely indicator of the potential for success, implementing sustainable and institutional environmental programs requires participation from a wide variety of individuals and departments, from senior leadership to frontline workers. In most facilities, environmental programs responsibilities are decentralized making the development of institutional goals and action plans a challenge. This section suggests a variety of different ways to create committees or teams, but the main objective is to create a broad framework to bring decision-makers and implementers together to make change happen.

There are potentially three different layers of leadership in a highly functioning environmental program:

- Environmental Leadership Council: Comprised of representatives from senior leadership that have the authority to make high-level institutional commitments and the ability to commit financial resources to those commitments

- Green Team (Ecology or Environmental Committee): Comprised of department director-level representatives from a variety of departments who have either operational and implementation responsibility for, or interest in, a variety of environmental programs

- Recycling coordinators (ecology or environmental coordinators): Departmental-level coordinators who have communications and some implementation responsibility in his/her department or area

Recruiting staff

Unless responsibility for environmental programs is somebody's full-time position, most participants on these committees serve on a volunteer basis. For the most successful committees, it's important to find the balance between staff that *must* participate versus those concerned and motivated staff that *want* to participate. For example, it is *strongly* recommended that the director of environmental services participate on the Green Team, but that person might not be the biggest advocate.

Environmental advocates and key clinical staff, both doctors and nurses, are always important members of the team.

Environmental Leadership Council

Environmental Leadership Council representatives have clout. The ELC is charged with high-level decision-making and might only need to meet on a quarterly basis. The ELC can support the funding of an environmental initiative where additional financial commitments may be required, for example, a new waste management system, water conservation effort, or the purchase of a product that is environmentally preferable but has an up-charge like recycled content copy paper. The ELC should adopt a statement of environmental principles to lead and direct the mission of the organization. The ELC might consider presenting the statement to the board of trustees. Any high-level facility goal can be addressed by the ELC.

Other examples include:

- a human resources initiative to formalize environmental programs participation as a part of every employee job description

- a new construction or renovation project—the ELC is in a position to adopt and actively support a goal of using the *Green Guide for Health Care* and Leadership in Energy and Environmental Design (LEED) certification

- a chemicals policy that might direct the institution's goal to support global efforts to reduce the use of toxic chemicals and, thereby, affirming the institution's core mission to improving health

Suggested participants for the ELC include

- board of trustees member

- chief operating officer

- chief financial officer

- chief medical officer

- vice president nursing

- vice president support services (which might include environmental services, safety, facilities, purchasing)

- environmental program leaders

Green Team
(Ecology or Environmental Committee)

Green Team representatives are responsible for the operations and/or staff that oversee a wide variety of waste and

Chemical Use and Waste Minimization/Solvent Recovery

Albany Medical Center in Albany, New York, is operating a chemical reclamation facility that annually recycles more than 50 percent of its RCRA-regulated chemical wastes, avoiding $1.7 million in removal costs and reclaiming 147 tons of chemicals for laboratory use at a value of $1.06 million since the program's inception in 1995. The program paid for itself in about six months.

environmental programs, typically, members are department directors or responsible staff members at similar functional areas. A Green Team has a multidepartmental perspective on designing and implementing programs. For example, the type of recycling containers appropriate for clinical areas may not be the best solution for administrative areas. The Green Team will also set yearly goals that include recycling, RMW reduction, hazardous chemical reduction, EPP strategies, energy conservation, water conservation, and preference for reusables. The Green Team chair can report to the ELC.

Suggested participants for Green Teams include:

- environmental services (including key
  waste handlers and supervisors)

- safety

- facilities

- nursing and medical staff

- infection control

- purchasing/materials management

- radiology

- laboratory

- other staff from key clinical departments or ad-hoc members as needed

A Green Team can also be created on a departmental level where the determination and development of specific action plans are made relevant to their setting. For example, an OR Green Team might include representatives from anesthesia, surgical services, radiology, or OR purchasing representatives. A Chemicals Reduction Task Force focused on the reduction of hazardous chemicals could include participants from the lab, housekeeping, and/or engineering.

Recycling coordinators

Recruiting staff in every department to help manage the waste management program is a great way to help environmental coordinators stretch limited resources by decentralizing some of the responsibility where it can be more efficiently and effectively implemented anyway—at the departmental level. Recycling coordinators serve as point people to provide critical communication to staff in their departments on recycling and waste management information. Implementing this program is easy and the long-term benefits make the program sustainable.

Recycling coordinators' responsibilities might include the following:

- Acting as communication liaison with the primary waste manager—for example, coordinators receive e-mail updates communicating how the entire facility is doing against waste management and minimization goals, which includes things that are going well *and* problems that need to be addressed. Coordinators then communicate this information to *all* staff via staff meetings, posting fliers or copies of e-mails, and by encouraging word-of-mouth information sharing.

- Monitoring waste containers in their areas for proper placement and labeling to encourage waste segregation and recycling. Recycling containers that are not color-coded, have no labeling and no coordinator responsible for monitoring its use, will guaranteed, have trash in it. Coordinators can request additional containers or labels as well as fliers and educational materials.

- Facilitating waste management education. Coordinators should ensure staff is aware of red bag minimization programs, recycling procedures, proper hazardous waste disposal, and all environmental program initiatives.

- Serving as a resource. Staff in the department should know who the coordinator is and that he or she is the person to go to with recycling and waste management questions. Coordinators are also the primary liaison with housekeeping staff and supervisors in the area.

The best coordinators are those who care about these issues. Having e-mail is helpful as the primary forum for communication. A department or area can have more than one coordinator if the department is too big for one, if there are evening/night and weekend staff that should have their own coordinator, or if there are different staff meetings or groups that the coordinator doesn't communicate with easily.

Conclusion

Waste is a measure of inefficiency. The evidence of this inefficiency in healthcare institutions across the country is clear when looking at the materials that are being tossed every day that equate to tossing millions of healthcare dollars while at the same time negatively impacting the environmental and health of the very communities in which they serve.

We already know what is desirable—solutions that are sound, practical, and provide both environmental and financial benefits. We know the obstacles to broad implementation that tend to be perceived as barriers, but perceived cost and risk factors are being dispelled as hospitals across the United States have shown that investing the resources into improving their environmental performance is a good and worthy investment.

There is a clear vision of the healthcare facilities of the future: high performance buildings that use less energy, less water, require fewer chemicals to maintain, that are designed for maximum operational waste management systems; where materials are purchased with health and the environmental considerations; where materials are used efficiently, staff take responsibility for and participate in waste minimization programs; and end-of-life considerations are maximized that include reuse and recycling. Today, there is a network of resources to tap into so that no facility has to start from scratch or go at it alone.

Author Biography

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Redefining Healthy Food:
An Ecological Health Approach to Food Production, Distribution, and Procurement

Jamie Harvie, PE

Introduction

Over the last century, we have radically altered the way we produce and distribute food. This transformation of our food and agricultural system has fundamentally affected the health of our planet and its inhabitants. We are already experiencing significant impacts in the form of increased antibiotic-resistant bacteria, poisoned air and water, food-borne pathogens, and collapsing rural communities. We are at the brink of inability to provide future generations with fresh air, water, and food.

The current obesity crisis is receiving attention, yet lacks the context of food production and ecologic impacts. Poor nutrition is a risk factor for four of the six leading causes of death in the United States: heart disease, stroke, diabetes, and cancer. Our current food system favors the production of animal products and highly refined, calorie-dense foods, rather than the fresh fruits and vegetables, whole grains, and other high-fiber foods important in prevention of these diseases. Hidden behind these nutritional imbalances is a food system reliant on and supported by methods of production and distribution that hurt our environment and us. Perversely, it is the obesity crisis that is providing the opportunity to re-examine our twenty-first century food and agriculture practices through a new health-conscious lens.

Furthermore, it has provided an awakening to the intricate relationship healthcare has with food production and ecological and human health. It is forcing a shift in awareness of the importance of healthcare's role in prevention and wellness and in developing national leadership with respect to the need to address the food system itself as a means to healthy food. Moreover, the obesity crisis is forcing a realization of our intrinsic connection to global health and ecological processes. Understanding these complex relationships gives us an opportunity to restore control over a situation that has pervasively influenced the health of humans and our environment.

Obesity in context

While the medical community has long recognized the importance of good nutrition, new food-related diseases have created a public health crisis and exacerbated the financial health concerns of medical institutions. Obesity is now the leading health concern (Anderson and Smith 2003). Diet-related medical costs for six health conditions—coronary heart disease, cancer, stroke, diabetes, hypertension, and obesity—exceeded $70 billion in 1995 (Nestle 2003). And, by virtue of the increased resources focused on obesity, the crisis has become an issue for everyone, overweight or not (Nestle 2003).

Almost one fifth of children and adolescents are considered overweight, and one-third obese (Ogden et al 2006). Obesity rates for children aged six to eleven have tripled since the 1970 (Institute of Medicine 2004), and 9 million children over the age of six are considered obese (Institute of Medicine 2004). Clinical interventions such as gastric bypass are escalating. The estimated number of hospital discharges with gastric bypass increased from 14,000 in 1998 to 108,000 in 2003 (Shinogle, Owings, and Kozak 2005). Clinical interventions are costly and not in keeping with successful public health strategies.

Furthermore, they are not sustainable. We are reminded by the Institutes of Medicine (Smedley and Syme 2000) that, "It is unreasonable to expect that people will change their behavior easily when so many forces in the social, cultural, and physical environment conspire against such change." A host of factors has been raised as potential contributors to obesity, including seemingly unrelated issues such as chemical pollution (Keith et al 2006). In short, for a variety of reasons, clinical approaches are not sustainable, and, as with any public health intervention, we need to approach the obesity crisis with an understanding of the broader context in which it is occurring.

An ecological approach

Food production, distribution, and procurement intersect a wide variety of issues. Economics, immigration policy, spirituality, agriculture and trade, culture, environment, and nutrition are but several of the myriad concerns associated with the food we grow and eat. And because food is also a fundamental human need, there is a strong cross section of organizations and interests involved in food and agricultural policy and practice. There is perhaps no issue that has such a wide depth of actively involved interests.

The complexity of interests requires a systems, or ecological approach. Such an approach is challenging because it is not linear and requires observation of the whole context, while seeking to understand the connections between their parts. Clearly, society is not eating more high-fat sugary foods because people woke up and decided that is what they wanted. A variety of forces has created an industrialized food system that markets and makes available inexpensive high-fat sugary food. By taking an ecological approach, we can attempt to see the complexity of interrelationships and, hopefully, provide a more useful analysis of the system. This complexity is blatantly apparent when we learn that, in the last several years, two of the largest food companies have purchased two of the nation's top weight-loss companies (Sorkin 2006). Yet, for the purposes of this discussion, we also discover that our industrial food system is not only implicated in the obesity crisis, but profoundly affecting human and ecological health by contributions to antibiotic-resistant bacteria, quality of our air and water, the decline of rural socioeconomic health, and others.

Background: The growth of modern agriculture

Before we explore these pressing human and ecological health concerns, it is important to understand some of the forces involved in the development of our current food system. As we will discover, the system has evolved to the degree that food and agricultural enterprises have become interchangeable. This synopsis attempts to explain some of the major forces involved in the transformation to a form of agriculture that would be unrecognizable to our parents or grandparents. It is especially important to appreciate this concept, since surveys demonstrate that most consumers, regardless of class or ethnicity, have little comprehension of how their food is produced today (Bostrom et al. 2005).

The development of our current food system has principally followed the same path as other sectors in our society—industrial capitalism and globalization. At the turn of the twentieth century, society was predominantly rural, and farmers maintained a livelihood. Farms were small, with a diversified output. Seed was collected and used for new season crops, and animal manure was used for fertilization. Crops were rotated to maintain fertility. Food was distributed to the local grocer or butcher. This farm model remained relatively constant until the middle of the twentieth century, when a variety of factors rapidly changed the nature of farming. Advances in transport efficiencies through the interstate highway system, improvements, and the development of refrigerated trucks allowed for distant delivery of "fresh" produce and meat. The discovery of ethylene and its role in the ripening of produce allowed for distant transport of food that could be artificially ripened during transportation (Halweil 2004). All of these "advances" allowed for distant distribution. Thus, the food industry began to grow and consolidate.

New scientific and technological knowledge developed during World War II further decreased the dependence of consumers on local and fresh food. Freeze-dried, dehydrated, and processed foods began to enter the marketplace. Pesticides and petroleum-based fertilizers began to be used as inputs, replacing crop rotation, manure, and diversification to maintain fertility and manage pests. Improved tractors and other farm equipment allowed farmers to engage in monoculture and increase farm size in their effort to achieve greater efficiency. Export-oriented agriculture was promoted through government programs.

Consolidation and globalization of the food system

Farmers began to outsource fertilizer, production, cleaning, and packaging their harvest, as well as other work they had routinely done (Halweil 2004). Ultimately, the processing and packaging industries became dominant, adding more economic value to the purchased product, and farmers became the suppliers of raw materials (Halweil 2004). In short order, farmer profits became costly to a rapidly consolidating industry. As an example, Iowa farmer profit margins have decreased from 35 percent to 9 percent since the 1950s (Halweil 2004). Agricultural polices and other socioeconomic factors further accelerated the rise of a highly consolidated agricultural food industry. Farm size grew, and the number of farms decreased. Since 1960, the number of farms has declined from about 3.2 million to 1.9 million, but their average size has increased 40 percent (Nestle 2003). Five companies now control 75 percent of the global vegetable seed market. Two firms control 75 percent of the world market for cereals, and, in the United States, four companies now control 80 percent of the beef packing (Halweil 2004).

Farmers whose operations fall between small-scale direct markets and large, consolidated firms manage more than 80 percent of farmland in the United States. These farmers are increasingly left out of our food system. If present trends continue, these farms, together with the social and environmental benefits they provide, will likely disappear in the next decade or two (Kirschenmann et al. undated). Rapid consolidation, initially in the seed and manufacturing sectors, but now in the huge food retail sector, means that, in the near future, roughly six multinational retail firms will determine not only the size of America's farms, but the type of management decisions made on those farms (Hendrickson et al. 2001). Similar to other global business models, the commercial interests that drive these large consolidated firms are based on three primary business objectives: the development of supply chains, biological manufacturing, and the reduction of transaction costs (Kirschenman 2002).

The industrial food system: Implications for health

Until the industrial food system was developed, farmers and farming played a pivotal role in stewardship of the land because the health of the land and their livelihood were mutually interdependent. Those who managed their land and animals well succeeded. Good management relied on the unique understanding of the natural environment, including rainfall patterns, native pests, temperature trends, soil fertility, etc. Their personal success (and by extension, the success of their communities), was inextricably linked to the farmers' understanding of the complex interaction of ecological processes. Healthy communities require healthy ecosystems, characterized by functions and systems that allow the maintenance of biodiversity, biotic integrity, and ecological processes over time (Government of British Columbia, undated). The industrialized food system divorces stewardship from food production. Experts (Kirschenmann et al. undated) have recognized that, "The development of supply chains means that on-farm decisions will no longer be made to benefit the long-term sustainability of the farm, or the good of the community, or the health of the natural resources that sustain the farm. The introduction of the concept of biological manufacturing means that farmers can no longer produce commodities based on what is best for the normal functions of the animals on the farm, or for the diversity of the landscape, or for the general health of the farm. Rather, farm management necessarily will be focused on technologies designed to produce uni-

> "For approximately the last sixty years, we have experimented with an attempt to impose an industrialized approach to agricultural production and the larger food system in which it is contained—and the system has responded with antibiotic-resistant bacteria, morbidity and mortality from nutrition-related diseases, water and air pollution, and food marketing. "

form products that meet the desired processing and retail objectives of the firm, which are, in turn, driven by economic return. And the need to reduce transaction costs means that consolidated firms will do business only with the largest farmers. It simply is less costly to contract with one farmer who raises 10,000 hogs than it is to issue contracts to ten farmers who each raise 1,000 hogs. All but the very largest farms will become residual suppliers."

In short, a tremendous shift has occurred in the nature of farming, and the important role of farming and agriculture in the protection of ecosystem health and, ultimately, human health. Fundamental ecological processes have been interrupted. The shift has transpired over the last sixty years and resulted in a predominance of large single farms producing single commodities requiring significant inputs. Large multinational food corporations battling for consumers' food dollars characterize the system. Our society has rapidly changed its food culture from one in which most food was cooked at home to one in which almost half of all meals are now eaten out. And we have shifted from a being a society in which most ate whole local foods to a one that eats highly packaged and processed foods transported great distances (Nestle 2003).

Obesity and beyond: The industrialized food system and health

As previously mentioned, a variety of forces have converged to change the nature of agriculture. We are now experiencing the strains throughout our healthcare system. While obesity is one health crisis, a wide variety of hidden health crises resulting from current agricultural practices are equally at play. These impacts to human health from industrialized food production and distribution methods are both direct and indirect. Importantly, the majority of these impacts is interrelated and is caused directly or indirectly by our intervention in and disruption of feedback loops regulating natural ecological processes and systems. Following are some examples of how our food system is having an impact on health.

Confined (or concentrated) animal feedlot operations

Confined (or concentrated) animal feedlot operations (CAFOs) may be considered industrialized protein-production facilities. They epitomize the extreme of our industrialized food system. These operations confine large quantities of livestock to a closed area where all food and water inputs are carefully controlled. They are defined as more than 1,000 beef cattle, 2,500 hogs, or 100,000 broiler hens; they generate an estimated 575 billion pounds of manure annually (IATP 2004). In some facilities, the quantities of animals produced number in the millions. From a management perspective, as capitalized ownership has consolidated, there has been a growing separation of the ownership, management, and labor of the operations, meaning that different people own, manage, and work at the factory farm. Contract growing is becoming commonplace, where family farmers sign away ownership of their animals through a contract with a major corporation (GRACE, undated). These animal operations are concentrated geographically.

Though not exclusive to CAFOs, a wide variety of feed additives are provided, including growth hormones, antibiotics in feed and water, and arsenic. Arsenic, though banned in European livestock production, is used domestically as a growth promoter to compensate for poor growing conditions and for pigmentation. According to the US Environmental Protection Agency (EPA), approximately 70 percent of the 8.7 billion broiler chickens produced annually are fed arsenic (Wallinga 2006a). In a recent study, 55 percent of raw, supermarket chicken contained detectable arsenic, and nearly 75 percent of breasts, thighs, and livers from conventional producers carried detectable arsenic (Wallinga 2006a). Arsenic causes cancer and

contributes to other diseases, including heart disease, diabetes, and decreased intellectual function. Even low exposures to this type of serious toxin are generally presumed to be risky (Wallinga, 2006b). In many areas of the country, groundwater used for drinking water may be naturally high in arsenic. The application of arsenic-laden manure further contributes to this drinking-water concern (Christen 2006).

The largest 2 percent of US livestock farms now produce 40 percent of all animals in the United States (Agriculture Research Service 2005). In 2002, half of all hogs in the United States were raised on large-scale farms that managed more than 5,000 hogs (GRACE undated). Ten companies produce 92 percent of the nation's poultry (Kratz 1998). In Utah, one farm will raise more than 1.5 million hogs in a year, creating the same amount of excrement as the population of the city of Los Angeles (Barboza 2000). The animal density creates tremendous logistical concerns for CAFO operations. So much animal waste is created that local soils have little capacity to absorb it all, creating water-quality and drinking-water effects. As the manure is often sprayed, it creates illness-producing odors in nearby communities. In 2002, both the Michigan Medical Society and the Canadian Medical Association called for moratoria on new CAFO construction (Michigan State Medical Society 2002). In 2003, the American Public Health Association (APHA) passed a resolution urging federal, state, and local governments and public health agencies to institute a "precautionary moratorium" on the construction of CAFOs because of health concerns (APHA 2003). These included runoff, community impacts, air-quality concerns, worker health and safety, and issues of antibiotic resistance.

Antibiotic resistance

One of the most important advances in treating infectious disease has been the development of antibiotics. Alarmingly, these compounds are now threatened by a global crisis of antibiotic resistance. Currently, 60,000 Americans die annually from resistant infections (Centers for Disease Control 2004). The Congressional Office of Technology Assessment calculated that, as of 1995, resistance by just six types of bacteria increased hospital treatment costs by $1.3 billion annually (Shea, Florini, and Barlam 2001). It is estimated that $30 billion is spent on the cumulative effects of antimicrobial resistance each year (including multiple-drug regimens, extra hospital days, additional medical care, and lost productivity) (American College of Physicians 1999). For four important drug/bacteria combinations, resistance increased by between 40 percent and 49 percent in just five years (1994–1999) (US Department of Health and Human Services 2000).

Even more disturbing is the growing prevalence of super bugs, bacteria that are multidrug resistant. As of 1998, strains of at least three bacterial species capable of causing life-threatening illnesses were resistant to *all* available antibiotics (Levy 1998). A wide variety of public health and medical organizations recognize the impending crisis. The World Health Organization (WHO) has stated that, "There is clear evidence of the human health consequences due to resistant organisms resulting from non-human usage of antimicrobials" (WHO 2003) and the Infectious Diseases Society of America states that a "perfect storm is blowing in the field of infectious diseases" (Infectious Diseases Society of America 2004).

Yet, it is estimated that more than 70 percent of all antibiotics consumed in the United States are used as feed additives for poultry, swine, and beef cattle for nontherapeutic purposes (Mellon, Benbrook, and Benbrook 2001). That is, they are used to promote growth and to compensate for diseases caused by poor animal husbandry, the very conditions provided by CAFOs. There is a strong consensus that agricultural usage contributes to antibiotic resistance in humans. The US Institute of Medicine/National Academies of Science states, "Clearly, a decrease in antimicrobial use in human medicine alone will have little effect on the current situation. Substantial efforts must be made to decrease inappropriate overuse in animals and agriculture as well" (Institute of Medicine 2003). More than 300 organizations, including the American Medical Association and APHA have advocated ending the nontherapeutic use of medically

important antibiotics as feed additives. While some producers have begun to reduce their use, it is difficult to independently verify, as there are no regulations that track usage. Moreover, because as much as 75 percent of an antibiotic may pass undigested through an animal, its waste can contain antibiotics as well as antibiotic-resistant bacteria and their genes (Campagnolo and Rubin 1998). Furthermore, antibiotic-resistant bacteria can move off the production facilities into communities via food, water, direct animal contact, and other pathways.

Water pollution: Animal wastes and nutrients

Over centuries, farmers developed methods to increase the fertility of their soils. They used animal pastures and rotations of clover and other nitrogen-fixing crops. The recent transition to an industrialized agriculture model and an associated trend toward monocultures has created a variety of negative impacts resulting from the interruption of ecological cycles that farmers understood and worked with synergistically. Since 1972, there has been a tripling of counties that have more that 55 percent of their plantings in corn and soybeans (Porter, Russelle, and Finley 2000). Corn and soybeans are two of the most overproduced crops. Twenty-five percent of all US farmland—80 million acres—now grows corn (Christensen 2002).

The concentration and relocation of animal production to the Southeast and West have created extreme manure problems in those areas, and the loss of pastures, crop rotations, and manure has depleted soil fertility in the Midwest. As a result, petroleum-derived nitrogen and other fertilizers must be added to soils. Poor nitrogen retention by corn and soy rotation results in contaminated surface waters that migrate to the Gulf of Mexico, where nitrogen creates massive annual algae blooms. These blooms metabolize all available oxygen, leaving a 20,000 square kilometer dead zone in the Gulf (Rabalais, Turner, and Scavia 2002). Thirteen percent of domestic drinking-water wells in nine Midwestern states had nitrates exceeding the safe drinking-water level of 10 mg/l (Henderson 1998). According to the EPA, hog, chicken, and cattle waste has polluted 35,000 miles of rivers in twenty-two states and contaminated groundwater in seventeen states (Environmental Protection Agency and US Department of Agriculture 1998).

Pesticides

Over half a century ago, farmers succeeded without synthetic pesticides. Today, the entire web of life is contaminated. From a human perspective, this contamination begins in the womb, where metabolites to common pesticides have been found in meconium (Whyatt and Barr 2001) and in fetal cord blood (Houlihan et al. 2005). Human infants are literally bathed in pesticides prior to birth as they go through intricate developmental processes and continue into life through exposure to pesticide contaminated air, water, and food. Pesticides and their metabolites are now routinely part of the human body burden, the load of chemical contamination carried by human populations (Environmental Defence 2005).

Environmental exposures are widespread. For example, concentrations of atrazine, alachlor, and broadleaf pesticide 2,4-D in rainwater have been reported to exceed the safe drinking-water standards (Gilliom, Alley, and Gurtz 1995). A 1994 study estimated that 14.1 million Americans drank water contaminated with the pesticides atrazine, cyanazine, simazine, alachlor, and metolachlor (Wiles et al. 1994). Extensive herbicide use in agricultural areas (accounting for about 70 percent of total national use of pesticides) has resulted in widespread contamination of herbicides in agricultural streams and shallow ground water. The chance of finding agricultural weed killers in house dust increases by 6 percent for every 10 acres of cropland found within a roughly 800-yard perimeter of a house (Raloff 2006). Farm-worker and community exposures are another concern. Use of agricultural chemicals known to cause cancer in California increased 127 percent from 1991 to 1998. Farm workers have a 59 percent to 70 percent greater risk of cancer (Reeves, Katten, and Guzman 2002).

In 1991, the US Geological Survey (USGS) of selected herbicides in eight rivers in the Mississippi River Basin found atrazine in all samples taken, with concentrations exceeding the federal drinking-water standard, or maximum contaminant level, in 27 percent of the samples (Goolsby, Coupe, and Markovchick 1991).

In a related water-quality assessment report (USGS 1999), USGS highlights several important points with respect to its water quality findings.

- Health effects of pesticides are not adequately understood.

- Most contamination occurred as pesticide mixtures and that no or limited experiments are done on mixtures.

- Breakdown products, for which there are no established standards or guidelines, may have effects similar to their parent pesticides.

- Water-quality standards and guidelines have been established for only about one-half of the pesticides measured in the water-quality assessment samples.

The report also suggested "effects on aquatic organisms may be greater than on humans in many agricultural areas." Although there are no US EPA aquatic-life criteria for the major herbicides, Canadian guidelines were exceeded at 17 of the 40 agricultural streams studied, most commonly for atrazine or cyanazine (USGS 1999).

Long-term low-level exposure to pesticides has been linked to an array of chronic health problems, including cancer, birth defects, neurological, reproductive and behavioral effects, and impaired immune function (Sanborn et al. 2004). Growing children consume far more food and water per body weight than adults, and their biological detoxification mechanisms are not fully developed. The Ontario College of Family Physicians has completed a literature review of pesticides and determined that, "The results of the systematic review do not help indicate which pesticides are particularly harmful. Exposure to all the commonly used pesticides ... has shown positive associations with adverse health effects. The literature does not support the concept that some pesticides are safer than others; it simply points to different health effects with different latency periods for the different classes (Sanborn et al. 2004).

It urges a focus on reducing exposure to all pesticides, rather than targeting specific pesticides or classes. It also clearly points out the severity of pesticide-related illness necessitates prevention, which is much more proactive and powerful than attempting to treat exposure. They encourage family doctors to learn about high-risk groups (women during childbearing years, occupationally exposed patients, children) and to then teach methods to reduce exposures. Finally, they suggest that physicians come together to convey health concerns to politicians who make regulatory decisions relative to pesticide use and public health (Sanborn et al. 2004).

It is worth recognizing the irony embedded within the pesticide problem. The more pesticide used, the greater natural-selection pressures work to develop resistance pests, requiring greater quantities or new pesticides. We now see a worldwide trend of increasing appearance of herbicide resistance, as predicted by Rachel Carson, author of *Silent Spring*, decades ago (Gunsolus 1999). We are concurrently affecting the health of the ecosystem by destroying ecosystem diversity while exposing human populations to a variety of agents with a host of health effects.

Energy use and air pollution

Actors in the transformation of our food system have included technological improvements, infrastructure investment, and cheap fuel cost. These have, in turn, permitted an ever-expanding reach for the least

expensive units of production and the best market for food companies. Food has become a commodity, and we now see a trend of agricultural imports and exports both rising rapidly. From 1993 to 2001, we experienced increases in food export and import of 25 percent and 57 percent respectively (Mamen et al. 2004). California imports and exports similar quantities of Brussels sprouts, cherries, and other products in a global food shuffle (Mamen et al. 2004). The California-grown tomatoes in a bottle of organic Heinz Ketchup, purchased in Oakland, make a roundtrip of 5,000 miles to Toronto, Ontario, for processing (Mamen et al. 2004). The distance from farm to market has increased about 20 percent in the last two decades, with food traveling between 2,500 and 4,000 miles before it reaches the plate (Pirog et al. 2001). Food in the United Kingdom travels 50 percent farther on average than it did two decades ago (Jones 2001), and trucks moving food account for 40 percent of all road freight. These are not for niche products, but include food staples such as apples, cheese, and garlic. Domestically, food and agricultural products (not including imported or exported foods) constitute more than 20 percent of total US commodity transport (Norberg-Hodge, Merrifield, and Gorelick 2002). In the United States, the average prepared meal includes ingredients produced in at least five other countries (Pirog 2003). We are literally burning through fuel in a global shifting of food and food products. As one would imagine, on-farm fossil-fuel use includes machinery such as tractors and refrigeration. But, the largest fossil-fuel source is the manufacture and transport of nitrogen containing fertilizers (Soil Conservation Council of Canada 2001).

A recent report by the United Kingdom agency, Defra, (Smith et al. 2005) highlighted the growing concern with food miles: "The rise in food miles (the distance food travels from where it is grown to where it is consumed) has led to increases in the environmental, social, and economic burdens associated with transport." The report continued, "These include carbon dioxide emissions, air pollution, congestion, accidents, and noise. There is a clear cause-and-effect relationship for food miles for these burdens—and, in general, higher levels of vehicle activity lead to larger impacts. Growing concern over these impacts has led to a debate on whether to try to measure and reduce food miles" (Smith et al. 2005).

It has been calculated that the use of imported ingredients for a basic diet can increase energy use and greenhouse gas emissions by 400 percent (Carlsson-Kanyama 1998). The localized human-health impacts from traffic congestion and related air pollution include low birth weight, increased cancer risk, and increased hospitalizations from asthma from a variety of air pollutants (primarily ultrafine particles, benzene, nitrogen oxides, carbon monoxide). Collectively, diesel-powered vehicles account for nearly half of all nitrogen oxides and more than two-thirds of all particulates from US transportation. The International Agency for Research on Cancer classifies diesel exhaust as a probable human carcinogen, and the US EPA has proposed the same classification. The California EPA estimates that 450 out of every million Californians are at risk of developing cancer due to diesel-exhaust exposure. The EPA estimates that fine particulates (PM$_{2.5}$) kill 20,000 people and hospitalize many more each year (Hoek et al. 2002, Wilhelm and Ritz, 2002. Zhu et al. 2002, Lin 2002). While food will still need to be transported to urban areas, clearly a decrease in quantity and quality of food-miles emissions is imperative. Importantly, 75 percent of consumers prefer that their food be domestically grown (Wimberley et al. 2003).

Rural communities and socioeconomic health

As industrialized food squeezes cost out of the system, small family farmers increasingly earn less return on every dollar spent, with marketers and input suppliers taking the rest. In 1990, farmers received nine cents on every food dollar spent, and, by 2000, that number had dropped seven percent, while farming costs had risen by 19 percent (Mamen et al. 2004). The average income on family farms is now negative, with off-farm jobs making up for the difference (Mamen et al. 2004). Depressed family incomes, high levels of poverty, low education, and social and economic inequities between ethnic groups are associated with land and capital concentration in agriculture (US Congress 1986). In communities with large indus-

trialized farms, we find a two-tiered income distribution with elites and a majority of poor laborers and no middle class (MacCannell 1983). In the United States, farm families are more than twice as likely to live in poverty, and, in Europe, a similar pattern is found (Pretty 1998).

Industrialized meatpacking is recognized as one of the most dangerous occupations; over one-quarter of all workers need medical attention beyond first aid. In the southeast region of Minnesota, a study found that the current economic structure extracts about $1 billion from the region's farm and food economy annually, equal to the amount of all farm products raised there (Meter and Rosales 2001). Collectively, the global food system has effectively externalized respect for human welfare and dignity. The Minnesota Bishops Statement on the Farm Crisis included recognition that, "These changes have moral and ethical implications which cannot be ignored…" (Flynn et al. 2000).

One might consider the AMA Declaration of Professional Responsibility, which "commits to respect human life and dignity of every individual, and to advocate for social, economic, educational, and political changes that ameliorate suffering and contribute to human well-being" (American Medical Association 2001) to be a similar rallying call for the rural farm crisis.

Food system interconnections: Food guidelines and food subsidies

While we have examined some of the larger system aspects influencing health, it is worth exploring some of the interconnections. While there are disparities, the US food supply provides a daily average of 3,800 calories. Even considering potential food wastage, there is a significant excess of calories in the food supply (Nestle 2003). It is argued that the excess supply forces intensive competition between food industry players for food dollars and that, to attract sales, food companies must market significantly and introduce new products. Since 1990, 116,000 packaged foods have been introduced and joined a marketplace that contains 320,000 items competing for supermarket space designed for far fewer items (Nestle 2003). In 1998, approximately 75 percent of the 11,000 food items introduced were candies, condiments, baked goods, and other convenience foods (Block 2004). In 2003, the US Department of Agriculture's nutritional education budget was $333 million, vs. the $1.2 billion budget for Pepsi alone, and $6 billion for food industry advertising. It is a reminder why a program that focuses on educating the public about the food pyramid and dietary guidelines won't work; there is just not enough money to compete in the marketing battle.

These food industry offerings are supported by US federal government subsidy programs, which favor five crops—corn, wheat, cotton, soybeans, and rice—and account for two-thirds of all subsidies. On an annual basis, corn is consumed 1.2 percent as a vegetable, 8 percent as a sweetener, 50.1 percent as an animal feed, 2.6 percent as starch, 5 percent as alcohol (ethanol), 22.6 percent as exports, 10.3 percent as reserve stocks, and 0.2 percent as seed.

Vegetable growers and ranchers receive very little government money. As a result, if we were to compare food-pyramid recommendations with government subsidies, they would be almost perfectly at odds. Fruit and vegetables, those foods recommended by the pyramid, receive little support, while meat and grains receive by far the most support. The low commodity prices have allowed the food industry to replace sugar with high-fructose corn syrup (six times sweeter than corn) and have provided a low-cost fat (soybean oil), thus keeping sugary, high-fat food inexpensive. These subsidized, cheap, and nutritionally bankrupt products remind us of the complexities of our food system and the "fuel" that feeds it.

Interconnections and feedback loop: Chemical contamination of the food web

Interrelated with the issue of pesticides is the ubiquitous contamination of our food web with persistent bioaccumulative toxic compounds and those that act as "signal disruptors." Until recently, it was believed that the impact of a toxic compound was related to its dose and that this response was linear. There is

now evidence that a host of compounds act at minute concentrations and interfere with chemical signaling. A subset of these is able to interfere with the normal function of the endocrine system. This issue is relevant to the food system for a variety of reasons. For example, a variety of pesticides and a breakdown product from the common plastic polycarbonate, bisphenol A (BPA), has now been found to interfere with the ability of nitrogen-fixing bacteria to form a symbiotic relationship with their leguminaceous hosts (plant-like beans, peas, and alfalfa) (Fox et al. 2001). This relationship is a key ecological process that affects how nitrogen is made available for use by plants.

BPA is used to make polycarbonate plastic and readily breaks down, thus contaminating food and water. BPA reaches the human fetus in the womb at levels that are well within the experimental ranges shown to alter development. Studies link BPA to prostate cancer (Ho et al. 2006), insulin resistance and type two diabetes (Alonso-Magdalena et al. 2006), and there is growing evidence of its role in obesity, in which it has been shown to interfere with weight homeostasis by increasing fat-cell numbers and uptake (Masuno et al. 2002). BPA use is ubiquitous in the food system. It is used as a chemical liner in canned goods and in a host of other food-related applications, including the majority of plastic cutlery, dishware, hard plastic disposable glasses, and beverage bottles such as baby bottles and water bottles.

Another direct example of the intersection of chemicals and the food system is the issue of fluorotelomers. A class of these persistent bioaccumulative and toxic compounds is used in, or result from, the creation of a wide variety of food-related products, including nonstick cookware (such as Teflon) and grease-resistant food packaging such as microwave popcorn bags, fast-food and candy wrappers, and pizza-box liners. These compounds are contaminating food, water, and humans and are being discovered throughout the food web, including the bodies of polar bears (Kannan et al. 2001). Animal studies are now showing that these fluorinated compounds cause cancer, liver damage, growth defects, and immune system damage (DeNoon 2005).

These examples demonstrate once again the intricate feedback mechanisms within our food system. They further delineate the need for a systems approach with respect to the influence chemical contamination is having on our food system. Especially relevant is how the majority of the aforementioned food uses—packaged food, disposable dishware, etc.—help sustain a fast-food-packaged lifestyle.

Reconfiguring the food system with a health lens

No matter how we try to distance our food production from natural processes, in the end, the foods we produce are dependent upon delicate players in a complex system that has evolved over eons of time. Pollinators, nitrogen-fixing bacteria, microbes, temperature and light variations, etc., all play a role in intricate biological processes. For approximately the last sixty years, we have experimented with an attempt to impose an industrialized approach to agricultural production and the larger food system in which it is contained—and the system has responded with antibiotic-resistant bacteria, morbidity and mortality from nutrition-related diseases, water and air pollution, and food marketing. From a public health perspective, our current system has failed. We need a new approach for food production and distribution with a health focus. Such a system will be preventive in nature and provide the capacity for self-renewal. By recognizing the linkages between human and global ecology, we can envision a food system that works to support health.

Healthy food and a healthy food system

One good lesson from our experiment with our industrialized food system is that it has allowed us to understand what not to do if we want food that is healthy for consumers, the workers that grow it, and the environment that sustains us. And perhaps the most important principle is that agriculture should conform as close as possible to natural systems. While a variety of other indicators may exist, we can see that a food system that follows this principle might be represented by the following (Hird 2003):

- proximate, originating from the closest practicable source or the minimization of energy use

- healthy as part of a balanced diet and not containing harmful biological or chemical contaminants

- fairly or cooperatively traded between producers, processors, retailers, and consumers

- nonexploiting of employees in the food sector in terms of rights, pay, and conditions

- environmentally beneficial or benign in its production (reduced inputs such as pesticides, fertilizers, energy use, etc.)

- accessible both in terms of geographic access and affordability

- high animal-welfare standards in both production and transport

- socially inclusive of all people in society

- encouraging knowledge and understanding of food and food culture

Importantly, a wide variety of studies demonstrate the viability of these types of agricultural practices, and we are beginning to see a revolution toward a healthy food system.

A healthy food system

The industrialized model promotes supply chains, biological manufacturing, and the reduction of transaction costs. Considerable evidence shows that this model of large monoculture is actually less productive. In fact, small farms are more productive than large industrial farms, with as much as 1,000 percent more output per unit area (Rosset 1999). The advantage lies in the small farms' ability to produce diversified crops, thus providing various products throughout the growing season. The misconception that large industrialized farms are more productive frequently depends upon how productivity is defined. By defining production of a particular type of crop per acre, large farms with monocultures will necessarily be more "productive." If we are looking at food production per acre in tons, calories, or dollars, the poly-crop is far more productive for all farm sizes (US Department of Agriculture 2002).

Furthermore, studies have demonstrated that farms that rely on fewer inputs (petroleum-derived fertilizer, pesticides, etc.) are more efficient in use of land, nutrients, and energy and cost less to maintain than chemical-intensive monocultures (Halweil 2004). Moreover, a variety of studies from around the world reveal that organic farming (farming without synthetic inputs) can produce as much as and sometimes much more than conventional farms (Halweil 2006). A three-year Minnesota study demonstrated a direct correlation between year-round plant cover on the land and reintegration of livestock onto farms, with improved water quality and fish health in the streams. Profitability of farmers in the watersheds rose as the diversity of their farming systems increased (Boody et al. 2005).

Reduced pesticide use eliminates pesticide exposure to the consumers, with organic food providing the least amount of exposure to pesticide residues (Baker et al. 2002). A recent study revealed detectable metabolites of organophosphate pesticide (OP) residues in children eating a conventional diet. Once these children were placed on an organic diet, there were no detectable metabolites. Placed back on a conventional diet, the metabolites were again detected. This and an earlier study (Lu et al. 2006; Curl, Fenske, and Eglethun 2003) demonstrated that, on a daily basis, the majority of the exposures to OP insecticides among children are occurring through the diet and are the result of OP insecticide use on crops, rather than uses in the home, schools, and residential environments.

Benefits of integrated and small-scale livestock production that minimize and eliminate the need for inputs are obvious. Pasture-raised animals and small-scale production will allow for beneficial use of manure and can reduce and eliminate the need for synthetic fertilizers. By supporting healthy growing

conditions, we can eliminate the need for arsenic and nontherapeutic antibiotics. In a World Health Organization review of Denmark's elimination of nontherapeutic antibiotic use, a dramatic decrease in resistant bacteria was observed in animals, meat, and humans. In addition, eliminating the routine use of antibiotics in livestock reduced human health risks without significantly harming animal health or farmers' incomes (Wegener 2003).

A variety of studies are now providing evidence that the industrialized food system is having a detrimental impact on the nutritional quality of food. Recent studies of vegetables, fruits, and wheat find median declines since the mid-twentieth century of 5 percent to 35 percent in concentrations of some vitamins, minerals, and protein (Meyer 1997; Davis, Epp, and Riordan 2004; White and Broadley 2005). This has been attributed to the "dilution effect," through which yield-enhancing methods such as genetics, fertilization, and irrigation tend to decrease nutrient concentrations (Jarrell and Beverly 1981). A variety of studies have demonstrated higher nutrient levels in organic produce (Worthington 2001). The current beef-production system is supported by cheap grain inputs. As beef do not naturally have a high grain diet, antibiotics must be fed to help prevent resultant stomach infections. By feeding cattle on pasture, antibiotic use can be reduced, while at the same time providing healthier beef and milk. Grass-fed cattle almost always produce steak and ground beef lower in total fat than conventional beef and tend to result in steak with higher levels of omega-3 fatty acids and other beneficial nutrients. Pasture-raised dairy similarly tends to produce milk with higher levels of essential fatty acids.

The large-scale impact of the globalized food system has spurred the development of Fair Trade, an international third-party certification system that guarantees that farmers and workers in the global south receive a fair price for their product. While this label is most recognized for its coffee certification, as a result of the social and economic crisis in the domestic farm community, a working group was established to develop similar criteria for domestic agricultural production.

In the United Kingdom, the British Medical Association (BMA) has endorsed the work of the Fair Trade movement and has called on the BMA and all medical schools and hospitals in the United Kingdom to set an example by purchasing Fair Trade produce wherever such an alternative is offered. The interest in protecting environmental and social health is gaining momentum not only in the farm sector, but also in the rural economic development community. In Iowa, Woodbury County recently became the first county in the United States to promote organic farming by providing a property-tax rebate for farmers who convert from conventional to organic farming practices. This action was supported by data demonstrating the impact of industrialized agriculture on local economies. The county soon followed with its Local Food Purchase Policy. The policy requires the county to purchase locally grown organic food through its food-service contractor. The resolution has the potential to shift annual food purchases to a local farmer-operated cooperative, thus increasing local demand that will lead to increased production and processing. A study by the Leopold Center has demonstrated that, by eating five half-cup servings of local vegetables daily, Iowans would not only fulfill the requirements of the food pyramid, but would provide a net economic stimulus of more than 4,000 jobs to the State of Iowa (Swenson 2006).

Clearly, there is a recognition that our industrial food system is out of control. While still a small percentage of the national market, organic and other certified foods are the fastest growing segments of the food sector. Sixty-six percent of US consumers report they use organic products at least occasionally, and more than a quarter of Americans are eating more organic products than they did one year ago (Whole Foods Market 2004). Reasons cited for buying organic foods were that they are better for the environment (58 percent), better for their health (54 percent), and better for supporting small and local farmers (57 percent). In addition, 32 percent of respondents believe that organic products taste better; while 42 percent believe organic foods are of higher quality (Whole Foods Market 2004). The survey found that consumers felt that smaller scale family farms were more likely to care about food safety than large-scale industrial farms, and that it was important to know whether food is grown or produced locally or region-

ally (Roper Public Affairs and Media 2004). As numerous market analyses have shown, approximately 25 percent of today's food customers want the unique products that this second market can offer them. Among the attributes making these markets attractive to consumers is the knowledge that a family farmer locally grew their food (Pirog 2004).

Healthy food and the healthcare market

It is not only the consumer and retail marketplace that are beginning to influence the dynamic of our current food system. We are witnessing a transition in the marketplace in which hospitals and health systems are adopting a systems approach. Healthcare has realized that it is an important player in the food system, not only because of the tremendous resource it allocates to treating food and nutrition-related disease, but because it plays an important role through its considerable food budget.

Hospital food is big business. In 2004 alone, the top healthcare group purchasing organizations (GPOs) purchased approximately $2.75 billion worth of food (Food Service Director 2005). The total healthcare market for food and beverages is about $12 billion (Healthcare Food Service Management 2006). While patient food receives considerable attention in the media, it is cafeteria and catered food that make up the largest percentage of food in the budget, accounting for approximately 55 percent to 70 percent of hospital volume (Food Service Director 2005).

Hospitals and health systems are not only changing procurement practices to support a healthy food system; they are explicitly identifying the link between a healthy food system and healthy patients, communities, and the planet in their policies and programs. These systems are the pioneers in an ecological approach to preventive medicine.

Kaiser Permanente

Since 2005, Kaiser Permanente (KP) has distinguished itself as a leader in recognizing the need for advancing and implementing a sustainable food system approach. KP's vision includes the aspiration to "provide healthier food in a manner that promotes agricultural practices that are ecologically sound, economically viable, culturally appropriate, and socially responsible" (Kaiser Permanente 2005). KP has developed Healthy Picks criteria for its cafeteria and has piloted healthy vending, incorporating nutritionally and ecologically healthy choices. In November 2005, KP sponsored FoodMed, the first conference on healthy and sustainable food designed for a healthcare audience. It also has hosted training for its food-service contractors, putting them on notice about KP's intent to adopt a sustainable food approach. KP's food work is best known for adopting farmers' markets at twenty-five of its medical facilities, providing locally grown fresh produce and flowers for KP workers and the community. As KP shared at a presentation at the CleanMed 2006 conference in Seattle, its work has also included:

- setting criteria for healthy food and creating guidelines for implementing sustainable food sourcing, including a two-page sustainable food addendum to the request for information process for its food supplies;

- elimination of rBGH (an artificial growth hormone banned in most Western countries);

- development of a local food-distribution model, collaborating with the California Alliance with Family Farms to source locally grown produce from predominantly low-income, minority farmers; and

- specification of local sourcing and hormone-free meats and dairy and serving fresh fruit instead of sweets as dessert.

> "One good lesson from our experiment with our industrialized food system is that it has allowed us to understand what not to do if we want food that is healthy for consumers, the workers that grow it, and the environment that sustains us."

Catholic Healthcare West

Catholic Healthcare West (CHW) is the largest Catholic health system in the United States and, like KP, has been a leader in the development of a sustainable food-system approach. Some facilities are already far along. For example, Dominican Hospital in Santa Cruz, California, buys produce from a local, minority-run organic farm and has an on-site garden that provides produce and flowers for the facility. CHW was a co-sponsor of FoodMed and began its work by adopting a model food and nutrition services policy statement. This reads in part: CHW recognizes, "food production and distribution systems have wide ranging impacts on the health of people, their communities and the ecosystems in which they live... healthy food is defined not only by nutritional quality, but equally by a food system which is economically viable, environmentally sustainable and which supports human dignity and justice...CHW aspires to develop a healthy food system" (HCWH 2006).

As part of its first-year implementation plan, CHW is implementing an education program about the ecological impacts of the food system and surveying its dairy providers with a first-year goal to eliminate diary raised with the use of rBGH. CHW has also completed a systemwide review of its coffee procurement and coffee-preparation equipment to access its ability to introduce Fair Trade coffee. CHW was the first health system to sign the Healthy Food Pledge, sending a strong market signal to the food system.

Local examples

At the individual facility level, there are numerous other examples. These organizations have started small, and, in the words of one representative, have taken "baby steps." They demonstrate the possibilities even within small, financially challenged institutions.

Good Shepherd Medical Center, located in Hermiston, Oregon, has eliminated fat fryers, serves organic produce and rBGH-free milk, and has implemented a comprehensive approach to eradicate food additives. It has eliminated beef products and serves bison, which is naturally lean and can be served in the cardiac ward.

St. Luke's Hospital in Duluth, Minnesota, serves only Fair Trade coffee, offers organic fruit, serves rBGH-free milk, is introducing a locally grown organic salad bar, and provides wild salmon caught by a community member. St. Luke's also composts its food waste and has a comprehensive food-recovery program where unused food is provided to the local food bank. Last December, the annual holiday dinner, in which lunch is provided free to staff, served all local and/or organic food and was featured in the local newspaper and statewide on Minnesota Public Radio.

For the last ten to fifteen years, Fletcher Allen Health Care has been buying food and disposing of food waste using practices that benefit patients, staff, the local economy, and the environment. The hospital purchases locally grown—often organic—food, hormone-free milk and Free Trade coffee. It also composts its food waste and has provided local vegetables to its employees through an on-site vegetable stand.

Physicians Plus, a Madison-based health insurance company encourages its 95,000 members to join the community-supported agriculture (CSA) movement by subsidizing CSA memberships. CSA is a method for small-scale commercial farmers to have a successful, closed market by selling produce directly to consumer members through a system of regular local delivery or pick-up of fruits and vegetables.

Benefits

Perhaps one of the most overlooked aspects of the healthy food-system approach is the benefit that accrues to the hospital. Kaiser Permanente's farmers markets have been cited in numerous media and media markets with very positive exposure. St. Luke's very small stepwise program has been covered on statewide and regional radio and in national print media. National media has highlighted those facilities

that were signatories to the Healthy Food Pledge. This positive publicity was not the driving rationale, yet it has provided tremendous marketing and good will for these organizations.

Moreover, these programs have resonated extremely well within the local community. For example, media coverage of St. Luke's cited the numerous local vendors and producers supplying the hospital. Local food procurement creates an immediate connection with patients, staff, and visitors to the community and embeds the facility in the local community in a unique and positive fashion.

Healthcare as leader

Unquestionably, creation of a healthy food system is not a simple task and is not the role of one actor. Healthcare cannot do it alone. Yet, healthcare and the public health community can play a leadership role and historically have risen to the task. For example, success was achieved in advancing policy and legislation to remove lead from paint and fuel. Healthcare has provided leadership in raising an awareness of the dangers of tobacco smoking. Hospitals and healthcare systems that advanced the first smoke-free environments, and the American Medical Association called for divestment of cigarette companies. Over the last ten years, healthcare has laid the groundwork for national comprehensive mercury elimination by raising the awareness of mercury as an ecological health concern and by reducing and almost completely eliminating mercury use in healthcare. This has been achieved through support for mercury legislation, comprehensive education and advocacy, and implementation of alternatives by health systems and nursing and medical organizations.

We are beginning to see the same leadership through implementation of a similar precautionary and preventative approach to our food system. As Preston Maring (2004), a physician at Kaiser Permanente and leader in bringing farmers' markets to many of the Kaiser Permanente medical centers stated, "What can be more closely related to health than what we eat?"

In the same way that hospitals became some of the first organizations to model a prevention approach, we are now seeing the same sector stepping up to the plate to model healthy food practices.

Designing a healthy food system

The complexity of a systems approach will necessitate a variety of interventions. Moreover, some will not always be obvious. For example, should a facility purchase local or organically grown produce? One important step forward is to articulate a new vision regardless of the potential challenges along the way, allowing for a stepwise approach to that goal. The following paragraphs explain steps that healthcare leaders are beginning to explore and adopt.

Healthy Food Pledge

One action that health system and facilities have taken is to support Health Care Without Harm's Healthy Food Pledge. Without encumbering facilities with mandates, hospitals pledge to initiate a healthy food system approach. To date, signatories include top-100 hospitals such as Hackensack University Medical Center, Oregon Health Sciences University, Catholic Healthcare West, and a host of other facilities. The pledge sends an important signal to the marketplace and policymakers about their interest in local, nutritious, sustainable food.

Signatories agree to:

- Work with local farmers, community-based organizations, and food suppliers to increase the availability of locally sourced food.

- Encourage vendors and/or food-management companies to supply food that is, among other

attributes, produced without synthetic pesticides and hormones or antibiotics given to animals in the absence of diagnosed disease and which supports farmer health and welfare and ecologically protective and restorative agriculture.

- Implement a stepwise program to identify and adopt sustainable food procurement. Begin where fewer barriers exist and immediate steps can be taken. For example, the adoption of rBGH-free milk, Fair Trade coffee, or introduction of organic fresh fruit in the cafeteria.

- Communicate to GPOs interest in foods that are identified as local and certified.

- Educate and communicate within the system and to patients and community about nutritious, socially just and ecological sustainable food, healthy food practices and procedures.

- Minimize or beneficially reuse food waste and support the use of food packaging and products that are ecologically protective;

- Develop a program to promote and source from producers and processors that uphold the dignity of family, farmers, workers, and their communities and support sustainable and humane agriculture systems.

Healthy meetings and conferences

Healthcare professionals frequently attend conferences for professional development, and hospitals and health systems host a wide variety of workshops, conferences, and symposia, both on site and at local facilities. These events are extremely important because they help link the professional medical community to the marketplace. It would be logical to provide meat raised without nontherapeutic antibiotics at a meeting of those professionals who recognized their significant role in the development of antibiotic-resistant bacteria. Serving healthy food at conferences and meetings (and, importantly, letting consumers know through signage), tangibly connects health leaders to the issues they are working on and provides market stimulus.

At the FoodMed conference co-sponsored by KP, HCWH, and CHW, all food was local and/or organic and included names of the local farms. HCWH's CleanMed conference food was similarly sourced. By serving nutritious and healthy food, health systems can begin an educational process and support those conference centers and hotels willing to purchase resources from the local community. St. Luke's Hospital's local and organic staff party was another example of how organizations are successfully bringing the issue into the facilities. A potent aspect of local purchasing is that it centers the hospital facilities as community institutions. At the St. Luke's event, names of all the local producers were listed on the food dishes. In its cafeteria is a display board with photos and information on the local community members supplying the cafeteria.

Purchasing power

Hospitals and hospital systems are now becoming aware of their ability to use their purchasing dollar to affect change in the marketplace. Smaller facilities, such as St. Luke's, are asking their GPO to provide a level of service and product that heretofore has not been available. In February 2006, St. Luke's was quoted in *Food Service Director Magazine*, **"**We're part of VHA Novation—we have the buying power of the entire VHA. But as a small, locally run, independent hospital, we must put the pressure on US Foodservice and Novation to get things we want. They haven't negotiated any contracts that cover rBGH-free milk. These GPOs need to start listening to their member hospitals, and when little St. Luke's says we want organic, locally grown, antibiotic-free, they need to listen."

Hospitals are also recognizing a variety of hurdles at the distribution level. For example, food-service departments typically order from their distributor's electronic catalogue, but these sophisticated databases provide almost no information on those products supportive of a healthy food system. They do not provide information on whether the product is domestically or locally produced, produced without nontherapeutic antibiotics, organic (or other certifications), rBGH-free, or other attributes that support a healthy food system. The system does not screen foods based on a particular hospital's criteria, such as foods high in sugar, salt, CAFO produced, trans fats, or other. Yet, the technology is available, and hospital systems and GPOs have the ability to preferentially award contracts to distributors and food-service contractors that support a healthy food approach. The supply chain will respond to its market. By using contracting power and requiring disclosure, hospital and health systems can send important signals and change the supply chain.

Developing marketing-free zones, not free-marketing zones

There is good understanding of how the soft-drink industry has been able to use vending-machine revenue to gain access to schools. Most vending-machine contracts provide a financial return to host schools or other businesses. This revenue frequently funds after-school activities, and, if school budgets are tightened, these activities become dependent on the revenue from the vending machines. Attempts to rid schools of high-sugar vending then run into conflict with those programs dependent on vending revenue.

This model parallels that in healthcare. Most food-service departments count on the revenue from their vending machines to augment their budget. If the food-service department budget gets reduced, then that department becomes reliant on the vending-machine revenue and, in short order, the facilities have become complicit in selling sugar to patients, visitors, and staff.

Another symbol of unhealthy food and food habits are fast-food establishments. According a recent study, 38 percent of the nation's top health institutions have a fast-food facility on site. (University of Michigan Health System 2002). With cost containment as a constant healthcare concern, one can understand the appeal of a fast-food chain to a healthcare food-services director searching for a way to cut cafeteria costs, increase customer satisfaction, and potentially increase revenue. In light of considerable evidence for the food industry's aggressive marketing campaigns, including research on food marketing to children, the appeal to the fast-food industry of having a franchise within a healthcare facility is obvious; a healthcare franchise would be an important marketing target because fast food would have instant health legitimacy through its healthcare alliance. On first glance it is a win-win, yet for an industry interested in supporting good eating habits and providing leadership, fast food-healthcare relationships are creating heated dialogue in nations around the globe.

To add an additional layer of complexity, there is an important subtext that should not be lost. If fast food—greasy hamburgers, French fries—is unhealthy, healthcare facilities should take them off their cafeteria menu as well. Or at a minimum, they should begin a transition and serve local and/or grass-fed beef or bison and potatoes, eliminate food additives and trans fats, adopt appropriate portion sizes, and eliminate bundling (buy a burger and get a free soda).

The food industry has spent time and money to understand how to motivate and interest consumers in its products. Healthcare organizations can take a hard look at how they can provide a necessary service—snacks or meals to patients or staff—without reinforcing food-industry messages whose primary interest is profit, not health. Hospitals and health systems can be models for food marketing-free zones through the elimination of large advertisements on vending machines, food-industry advertisements on cups and food tray liners, and sponsorship of healthcare-related events.

Healthcare leaders can say that it is unethical to market to children. While this industry has the legal right to do so and may provide significant short-term revenue, the long-term costs are now becoming apparent. If the AMA called for divesture from the cigarette industry, it might be worth exploring cutting similar ties to the food industry.

Farm and agricultural policy

At the state and local levels, there are wide variety of legislative initiatives that can benefit for healthcare's involvement, including funding support for sustainable agriculture, organic and/or local procurement preferences similar to the Woodbury County legislation, rebuilding of local meat and food-processing capacity, food-labeling initiatives, and many more. In 2007, the US Farm Bill will be reauthorized, with hundreds of programs that will have huge impact on our food production and distribution. While many parties will be at the table advocating for their interests, it is extremely important that healthcare add its voice. Healthcare leaders have an opportunity now to provide input on what a Farm Bill with a health lens would look like—one that values healthy diets, is ecologically protective, and fosters a vibrant sustainable agricultural economy.

There is a strong and growing constituency that supports a healthy food system and could benefit from healthcare's involvement. Yet, regardless of healthcare involvement from a legislative-policy perspective, healthcare's interests will only be strengthened by building the examples and models of hospitals advancing an ecological healthy food system through policies and practices from the ground up.

Challenges

We have arrived at a critical point in time, as we experience a multitude of negative health impacts from a food system that is out of control and exacerbating healthcare's financial crisis. The public has little understanding of where and how food is produced. By recognizing the complexity of interactions between food production and health, we can begin to address health problems through preventive interventions and build a new, healthy food system. It makes sense that the healthcare industry would be the messenger.

One challenge with respect to implementing a healthier model will be the concern that short-terms costs may be higher. As Nancy Gummer, RD, nutrition service director at Good Shepherd Medical Center reminds us, "What we're discovering is, it's a perception that doing the right thing is more expensive...It's not a reality... I haven't been a month over budget, on food or anything else." Even if it were, a hospital comes out ahead, Gummer said. "When you're looking at food costs and health costs, you can't look at, 'How much per pound am I paying?' You have to look at the whole picture. Healthier people use less healthcare resources" (Cole, 2006).

Though Americans have some of the cheapest food, the true costs (social justice, environmental burden, health impacts, etc.) have been externalized. Yet, since most people do not understand how food is produced and distributed, these issues go unnoticed. Throughout the supply chain, food is seen as a commodity, but it is clearly not an undifferentiated product. How and where it is produced can significantly change not only its quality, but also a cascade of cultural and ecological health impacts. Accordingly, dieticians, food-service directors, nursing and medical staff, and others have not thought about the health attributes of food beyond nutritional quality. As a result, there will be debate over how we define healthy food. Is it defined strictly by nutritional quality or are there other elements to consider? And, while there is growing awareness, environmental health is still seen as distinct from human health, as is social justice. Gummer further reminds us of fundamentally important questions, "What's the healthiest food I can feed these patients? How can the food we buy contribute to the health of the environment we're living in?" (Cole 2006).

As we approach a systematic problem, it can be helpful to acknowledge that change will make some people uncomfortable, and as the marketplace shifts, not everyone will benefit. Unquestionably, we need more production of fruits and vegetables. Our food system does not support local production. As new models of local distribution evolve, they may challenge existing models. It makes sense to build a new food system that provides a transition that attempts to benefit all members of the community.

Healthcare is habituated to technological fixes and tends not to reward prevention. The breadth and burden of the obesity crisis may be big enough to awaken healthcare to the need for a systems approach. By contrast, sustainable agriculture is a systemic approach involving low technology. Reconciling these functional differences may be complicated, but discussions are necessary with respect to allocating healthcare dollars for both treatment and prevention.

At times, approaching change will raise more questions than answers. For example, although we can estimate treatment costs associated with increases in antibiotic-resistant bacteria, we do not know with certainty whether this occurs from agricultural use or clinical use, in spite of knowing that the majority of nontherapeutic antibiotic uses are in agriculture. Furthermore, we know that pesticides have contaminated the entire food web, and that pesticides are associated with negative health effects. However, we cannot accurately assess the mortality or morbidity associated with pesticides. Still, attempting to reduce unnecessary usage of nontherapeutic antibiotics and pesticides in light of their potential to produce harm represents a precautionary approach embraced by healthcare—a sense of acting protectively in spite of gaps and uncertainties in the established science. A precautionary approach can seem at odds with the evidence-based approach promulgated in healthcare, even though they both employ available science. They are simply used for different applications. We will need to recognize how and when to use these tools.

Conclusion

Until recently, humans have been able to dissociate their activities from ecological processes. The air, water, and land have carried the burden of these activities. As our population and activities have increased, we now have little room for error or disregard. We are reminded from the recent United Nations Millennium Ecosystem Assessment, "At the heart of this assessment is a stark warning. Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted" (United Nations 2005). Increasingly, we are recognizing that we cannot be healthy on an unhealthy planet.

"Increasingly, we are recognizing that we cannot be healthy on an unhealthy planet."

Over the last sixty years, we have developed a food system, which, on its face, is very efficient. This food system is dependent on a practice of agriculture completely at odds with the functioning of natural systems. We have developed synthetic inputs, decreased diversity, and contaminated the food web. We have evolved a food system that supports and has accelerated a high-technology industrialized agriculture, which is now out of control, critically affecting cultural, social, and ecological systems. We are at a crossroad. We can choose to continue to intervene and tweak an incredibly complex network of relationships and feedback mechanisms and hope that we understand these dynamic intricacies that have evolved over eons of time, or we can advance an agricultural model that works in concert with these ecological processes. Healthcare leaders are playing a decisive role in advancing a food system that is healthy for patients, communities, and the planet. What leaders must recognize is that, ultimately, such a system is imperative for human, community, and global health.

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Toward an Ecological View of Health:
An Imperative for the Twenty-First Century

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> Nature's goods and services are the ultimate foundations of life and health, even though in modern societies this fundamental dependency may be indirect, displaced in space and time, and therefore poorly recognized.

> — Lee Jong-wook, Director-General 2003-2006, World Health Organization,
> *Ecosystems and Human Well-Being: Health Synthesis,*
> a report of the Ecosystem Millennium Assessment,
> United Nations Environment Program

> The growing prevalence of chronic conditions such as diabetes, heart disease, and obesity will overwhelm attempts to fine-tune the delivery system if there are not strong benefit plans and a focused approach to disease management and prevention and wellness.

> — Ronald M. Hollande, President and Chief Executive Officer,
> Massachusetts Hospital Association, *Boston Globe,* July 15, 2006

At the beginning of the twentieth century, the quality of medical education and practice was haphazard and poorly regulated by professional or other institutions. The *Flexner Report,* commissioned by the Carnegie Foundation in 1910, concluded that medical practice was not sufficiently informed by science and that medical education should be designed so that physicians would be well-grounded in science and the pathophysiology of disease. The adoption of these recommendations, along with other social, cultural, economic, and political forces, helped to shape the trajectory of twentieth-century medicine. The medical profession acquired substantial power and authority, while scientific understanding of the origins of disease dramatically advanced (Starr 1982).

During this time, and not just coincidentally, the paths of medicine and public health diverged. Broadly speaking, medicine focused primarily on the pathophysiology and treatment of diseases, while public health emphasized disease prevention. To some extent, the two fields have competed for resources and authority ever since, and each has made important contributions. Improvements in sanitation, working conditions, housing, nutrition, care for poor people, and infectious-disease prevention dramatically improved the public's health. Technological achievements based on advances in biomedical understanding, translated into medical interventions, led to marked improvements in the outcomes of many diseases.

But technological achievements that emerged out of what is now a vast medical industrial complex have come at a steep price. In the United States, as a percentage of gross domestic product, medical expenditures grew from 5.1 percent in 1970 to 16 percent in 2005 (ASPE Issue Brief 2005, Kolata 2006).

Before designing the twenty-first century hospital, we should ask whether the healthcare system should continue on its twentieth-century path. Where is that path going? Is this relentless growth sustainable and will it continue to deliver value? To whom? Are there new opportunities for the healthcare sector to make unique contributions to the well-being of individuals and their communities? What are the determinants of health? What is health? To the extent that they address disease prevention at all, most health-

care professionals and institutions concentrate on well-established, proximate causes of disease, rather than more distal or structural causes. Are there new opportunities and responsibilities for disease prevention? What are the relationships among medicine, public health, and environmental health? How are those relationships reflected in current institutional structures and practices?

Until these questions are addressed, it is impossible to know if the services provided by healthcare institutions are appropriate for delivering real value to their communities. And, without knowing what the mix of services and activities ought to be, discussion of building and infrastructure design is premature.

In the sections that follow, this paper addresses four basic themes.

First, as with all forms of life, humans are fundamentally dependent on environmental quality and ecosystem services for their well-being and quality of life. Locally, regionally, and globally, ecosystems and the services that they provide are under considerable stress and undergoing rapid change unique in human history with profound implications for human health.

Second, the healthcare sector not only treats people whose illnesses are in part or whole attributable to environmental conditions, but also contributes in multiple ways to environmental degradation that fosters ill health.

Third, the healthcare sector has both an opportunity and a responsibility to address these realities by modifying practices and modeling behavior in ways that demonstrate an understanding of ecological health. Ecological health embraces the deeply fundamental complex interrelationships that collectively influence human and environmental health.

Finally, as the costs of medical care continue to increase, we will increasingly come face to face with the uncomfortable question: How much are we really interested in disease prevention and health promotion and restoration?

Relationships between human and environmental health

Since life emerged on the planet 3.5 billion years ago, organisms have entered into a co-evolutionary, dialectic relationship with their environments in which each changes the other. Although modern humans evolved about 120,000 years ago, the qualities of ecological change created by population growth and technological achievements throughout the past several centuries, accelerating in the past fifty to one hundred years, are unique and deserve a closer look.

In 2005, the United Nations released the largest assessment of the health of the earth's ecosystems ever undertaken (UNEP 2005). More than one thousand experts from ninety-five countries prepared the report, which was then reviewed by a large independent board of editors and commented upon by hundreds of experts and governments before being released.

Among the findings

- In the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history.

- Approximately 60 percent of the ecosystem services examined, from regulation of air quality to purification of water, are being degraded or used unsustainably.

- Between one-third and one-half of the land surface of the earth has been transformed by human activity.

- The changes have contributed to substantial net gains in human well-being and economic development for many people.

- These gains, however, have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, exacerbation of poverty for some groups of people, and growing disparities and inequities.

- In the past 50 years, the world's human population has increased from 2.4 billion to 6.4 billion people. Much of this growth has occurred in increasingly large cities where mega-slums proliferate. Mega-slums are incubators of new and re-emergent diseases that can quickly travel across the world via air travel. Greed, inequity, poor planning, and disrespect for human rights create the slums and tend to intensify the earth's natural forces.

- Those forces, ecological and biological, do not always behave predictably. Changes in ecosystems increase the likelihood of nonlinear changes (including accelerating, abrupt, and potentially irreversible changes), with important consequences for human well-being. Growing pressures from over-harvesting, climate change, invasive species, and nutrient loading push ecosystems toward thresholds that they might otherwise not encounter.

- Economic globalization forges ahead without concomitant investment in a global public health infrastructure. This is a formula for catastrophe.

- Large numbers of plant and animal species have been driven to extinction, and most marine fisheries are severely depleted. More than half the world's coral reefs are threatened by human activities. Loss of species and genetic diversity decreases the resilience of ecosystems (the level of disturbance that an ecosystem can undergo without crossing a threshold to a different structure or functioning).

- Positive carbon balance (net increase of carbon released into the atmosphere and oceans) has resulted in global climate change, greenhouse gas effects, and increased acidification of oceans threatening the marine food web.

- Anthropogenic nitrogen fixation from fertilizer production and use and fossil-fuel combustion exceeds all natural terrestrial processes combined. Nitrous oxides are greenhouse gas and ozone precursors. Nitrates contaminate ground and surface water and, along with phosphorous, cause eutrophication of marine and fresh-water systems, algal blooms, attendant health risks, and fish depletion.

- Over the past 50 years, there has been an accelerated release of artificial chemicals into the environment, many of which are long-lived and transformed into byproducts whose behaviors, synergies, and impacts are not well-known. Humans are at risk from inorganic and organic pollutants present in food and water.

Ironically, most but not all of the ecosystem damages were the direct or indirect result of attempts to meet demands for ecosystem services such as food, water, timber, fiber, and fuel. While it may be easy to conclude from this that these are basic human necessities and ecological decline is inevitable, it is important to remember that (1) there are choices among ways to satisfy these needs and (2) wants and needs are not the same.

Relevance to the healthcare sector in the United States

These findings are relevant to the healthcare industry for at least two reasons. First, human health trends in the United States are strongly influenced by these ecological changes, either directly or indirectly. Second, the healthcare industry substantively contributes to ecosystem degradation domestically and globally.

Asthma, neurodevelopmental disorders, some kinds of cancer, some birth defects, mental illness, obesity, diabetes, premature births, and newly emerging and some recurrent infectious diseases are all increasing in the United States and throughout much of the world (US Dept. of HHS 2005, NCI 2006). These trends result from direct and indirect impacts of multiple interacting factors acting within a broad conceptualization of a changing ecosocial environment. Alone or in various combinations, dietary inadequacies or excesses (e.g., micronutrient deficiency, excessive fat or carbohydrate intake, etc.); exposure to toxic chemicals and pollutants in air, water, or food; inadequate exercise; exposure to infectious agents; and social and economic deprivation contribute to these trends. People with these environmentally related disorders live, work, play, and go to school in our communities.

The United States spends far more per capita than any other country in the world on healthcare (Bureau of Labor Education 2001). Capital equipment, buildings, operations, material throughput, transportation, water and electricity demands, and pharmaceuticals contribute significantly to these growing expenses. A large and growing environmental footprint (Rees, Wackernagel, and Testemale 1996) of this medical industrial complex has direct and indirect impacts on human health domestically and globally. According to the US Department of Energy and US EPA Energy Star program, in 1999, medical facilities spent more than $6.5 billion on energy (converted to 2004 dollars) (US EPA and US DOE 2006). The healthcare sector generates thousands of tons of waste each day—including toxic materials and chemicals—and still relies heavily on incineration to "treat" portions of the waste stream including pathological and chemotherapy waste. Tons of ordinary solid waste from healthcare facilities are also burned, resulting in toxic air emissions related to incineration (O'Brien 2005). Pharmaceutical products or byproducts are discarded or excreted into sewerage systems, contaminating surface waters throughout the United States (Kolpin et al. 2002).

Healthcare food-procurement practices support an industrial agricultural system heavily reliant on fossil fuels in food production and transport and petrochemical pesticide use. These practices directly contribute to air and water pollution, climate change, biodiversity loss, top-soil loss, eutrophication of surface waters, and adversely impact the social and economic fabric of rural communities (Tegtmeier and Duffy 2004). Moreover, this dominant agricultural system from which most healthcare systems obtain their food makes readily available a diet rich in calories but relatively poor in some nutrients, contributing to obesity, diabetes, and other adverse health outcomes treated in those same healthcare facilities (Nestle 2006; Davis, Epp, and Riordan 2004).

Despite ever-increasing expenditures, the health status of Americans is inferior to that of people in many other countries in the developed world. For example, a recent study concluded that, based on self-reported illnesses and biological markers of disease, late middle-aged US residents are much less healthy than their counterparts in Great Britain for diabetes, hypertension, heart disease, myocardial infarction, stroke, lung disease, and cancer (Banks et al. 2006). These differences exist at all points of socioeconomic status, despite the United States spending more than twice that of Great Britain per capita on medical care.

Today's healthcare institutions: What is their mission? What do they do?

Most healthcare institutions in the United States say that their mission is to provide high-quality care and service to diagnose and treat human illness. Some mission statements also mention disease prevention. In practice, disease-prevention activities usually entail individual behavior modification (smoking cessation, weight control, exercise, etc.).

Disease prevention sometimes merges with early diagnosis through screening programs (hypertension detection, mammography, colonoscopy, etc). Early diagnosis and intervention can help to prevent complications of certain conditions, but secondary prevention differs from primary prevention of disease before it occurs. Prevention efforts in the healthcare sector focus largely on proximal contributors to dis-

ease that are closely connected to the specific pathophysiology in question and about which there is little uncertainty. Causal factors that are more distantly related to the biological manifestations of disease, factors whose mechanistic contributions to disease processes are not well-understood, or factors for which data are limited tend to be ignored or given limited attention in clinical medicine.

Here are some examples.

- In clinical medicine, asthma prevention usually focuses on avoiding exposures to well-established asthma triggers subject to individual control such as cigarette smoke or dust mites in the home. The healthcare sector, however, is often silent about more socially determined factors such as outdoor air pollution, engine or incinerator emission standards, housing quality, city planning and traffic flow, stress, or labor standards that influence occupational exposures to asthmagens over which individual employees may have little control. Even within healthcare institutions, efforts to remove asthma triggers or causal agents from indoor air are often initiated only after aggrieved staff or outside activists complain loudly rather than avoiding the culprits altogether by intentional upstream design (Massachusetts Nurse 2005).

- Some kinds of cancer (e.g., prostate, brain, pancreatic, lymphoma, leukemia) are repeatedly positively associated with pesticide exposure in epidemiologic studies, although details of individual susceptibility and mechanistic understanding are limited (Ontario College of Family Physicians 2004). Not only is this information largely unknown within the healthcare sector and rarely taught in medical or nursing schools, but also, even when known, uncommonly leads to policy recommendations without considerable pressure, usually applied by advocacy groups. A few healthcare facilities, sometimes prodded by activist nurses, have begun to adopt policies that reduce the need for pesticides and restrict their use. Beyond the facility, however, in the United States, it is highly unusual for healthcare professionals or institutions to weigh in on community-based initiatives intended to reduce local or regional pesticide use.

- Despite overwhelming evidence of the importance of diet and nutrition for human health, many healthcare facilities ignore obvious opportunities for modeling disease prevention by serving food to patients, staff, and visitors that is appealing, optimally nutritious, and produced in ecologically sustainable ways. Some hospitals even lease space to fast food restaurants selling food that contributes to diseases treated in that same institution. Moreover, the agricultural system supplying much hospital food employs practices that profoundly degrade ecosystems domestically and in other parts of the world (Tegtmeier and Duffy 2004).

- The importance of social class and economic status as determinants of health is undeniable. Disparities in health outcomes across social class are not fully explained by individual risk factors such as diet, smoking, and exercise. Rather, lower social class is independently related to poorer health (Marmot 2005). Similarly, stress is independently causally related to a variety of adverse health outcomes. Yet, the ways in which these variables impact the pathophysiology of disease are often insufficiently understood to attract the intentional intervention of clinicians or healthcare facilities on a community or societal level. The healthcare sector traditionally sees its role in preventing the social determinants of disease as limited or the responsibility of others.

Some institutional mission statements mention an obligation to contribute to the health of the surrounding community. This may be accomplished in various ways—perhaps by providing free care to indigent community members, free disease-screening opportunities from time to time, or supporting various community activities. By doing this, institutions acknowledge responsibilities beyond institutional walls and, in some ways, address traditional public health concerns. But most healthcare institutions do not intentionally focus significant resources on favorably influencing community determinants of health.

In short, to the extent that the healthcare sector addresses disease prevention at all, it tends to focus on prevention of well-established proximal causes, while largely ignoring what epidemiologist Geoffrey Rose (1992) called the "causes of causes" (see also Krieger 1999).

First and foremost, healthcare institutions are really disease-care institutions. They provide care for people who are ill or injured. Programs aimed at primary-disease prevention are limited. To a large extent, healthcare institutions ignore or give limited attention to the range of environmental factors that directly or indirectly influence the health of their clients. They may justify this based on a restricted notion of their role, believing that many of these issues are in the domain of public health or environmental protection and not medicine.

Recent attempts to re-examine the distribution of roles and responsibilities related to human health call for closer collaboration between medicine and public health and re-thinking professional and institutional boundaries (Lasker 1997, IOM 2003). The realities of the early twenty-first century suggest that ecological health should be explicitly added to this collaboration. What is the potential role and responsibility of healthcare systems to address a fuller range of causes of morbidity and mortality in the communities that they serve? Given the steady growth of already oversized health (disease) care expenditures, this question becomes increasingly relevant as healthcare institutions consider their missions and plans for the future.

What Is Health?

Some people think of health as the absence of disease. The World Health Organization says that health is a state of complete physical, mental, and social well-being and not merely the absence of disease. The Institute of Medicine (1988) says that public health is "what we as a society do collectively to assure *the conditions* in which people can be healthy" [emphasis added].

An ecologist might define health differently. Aldo Leopold (1949) concluded from his field work that health is the capacity for self-renewal. Essayist, farmer, and ecologist Wendell Berry (1995) says that health is membership. The word *health,* he said, comes from the same Indo-European root as *heal, whole,* and *holy*. To be healthy is to be whole. To heal is to make whole.

Berry went on to ask, "Can our present medical industry produce an adequate definition of health? My own guess is that it cannot do so. Like industrial agriculture, industrial medicine has depended increasingly on specialist methodology, mechanical technology, and chemicals; thus, its point of reference has become more and more its own technical prowess and less and less the health of creatures and habitats. I don't expect this problem to be solved in the universities, which have never addressed, much less solved, the problem of health in agriculture. And I don't expect it to be solved by the government."

Ecological health: A new and necessary responsibility for medicine and public health

When viewed as separate domains, many relationships among individual, public, and environmental health are either unapparent or ignored. Viewed as nested spheres, however, one contained within the other, vivid patterns and relationships become clearer and demand attention. Individual health cannot truly be realized independent of public and environmental health. Similarly, public and environmental health depend to a large degree on the health of individuals. Artificial boundaries drawn among these concepts for professional, social, political, and economic reasons tend to obscure their intimate inter-relationships.

As we enter the twenty-first century, the healthcare sector would do well to ask once again: What is health? How is health dependent on the status of the community and ecological systems? What are our impacts, roles, and responsibilities in each of these domains? What would a *Flexner Report* for the twenty-first century say about the quality of medical education and the science that should inform medical practice? Without seriously considering these questions, we are unlikely to serve human communities and the planet well in the future.

Disciplinary isolation and specialization, along with sociopolitical and economic choices, have encouraged the

sprawling medical-industrial complex to focus narrowly within complex causal webs of disease. Public health practitioners emphasize the health of communities with a stronger emphasis on primary prevention through more systemic interventions. Medicine, nursing, and public health, however, do not give consistently coherent attention to the status of larger ecological systems in which people live. This needs to change. Instead of ignoring and, in many cases, actually facilitating the degradation of ecological systems on which human health depends, medical and public health practitioners have unrealized opportunities to transform their practices and embrace responsible, restorative membership in a larger planetary community.

As the healthcare sector plans for the twenty-first century, current circumstances, briefly summarized above, establish additional context for designing appropriate services, facilities, operations, and community involvement. In an ecosocial model of health and disease, based on the best available science, medicine and public health inescapably share membership with the planet's ecosystems upon which peoples' health depends. Much of clinical medicine in the United States is based on technologies that are unsustainable over time and cannot be transferred to other parts of the world because of economic and other resource constraints (Pierce and Jameton 2003). Although quality of care and financial considerations will always be important influences on healthcare policy, a strong case can also be made for including an expanded view of bioethics in decision-making.

Bioethics is often confused with medical ethics, but the two are really quite different, although overlapping. Medical ethics predominately address autonomy, beneficence, nonmalfeasance, and distributive justice. The emphasis is on the individual rather than community, connection, and inter-relationships. Bioethics has a more expansive perspective. Humans are situated within larger complex ecological systems that also deserve moral consideration (Jameton 2005). Oncologist Van Rensselaer Potter from the University of Wisconsin introduced the term *bioethics* in 1970. He saw the concept as biology, combined with diverse humanistic knowledge, forging a science that sets a *system of medical and environmental priorities for acceptable survival* [emphasis added] (Potter 1988).

Potter was strongly influenced by ecologist Aldo Leopold and geneticist C.H. Waddington. For Leopold, land was a collective organism—not merely soil, but "a fountain of energy flowing through a circuit of soils, plants, and animals." People, he said, are "plain members of the biotic community" (Leopold 1949). Leopold argued that a thing was right when it tends to preserve the integrity, stability, and beauty of the biotic community. It was wrong when it did otherwise. He said that ethics and beauty should play an important role in deciding how to live on the earth, and he developed a "land ethic." In this ethic, health is maintenance of the capacity for self-renewal. Leopold thought that three things were necessary to protect and preserve the ecological systems on which all species depend. One is the formulation of mechanisms for protecting the public interest in private land. Another is the revival of land esthetics. The third is refinement of restorative practices. Out of these three forces, he thought, "may eventually emerge a land ethic more potent than the sum of the three, but *the breeding of ethics* is as yet beyond our powers. All science can do is to safeguard the environment in which *ethical mutations* might take place" [emphasis added] [Leopold 1949].

Geneticist C.H. Waddington thought that "what is demanded of each generation is a theory of ethics which is neither mere rationalization of existing prejudices, nor a philosophical discourse so abstract as to be irrelevant to *the practical problems with which mankind is faced at that time* [emphasis added] . . . We can, with perfect logical consistency, conceive of an aim or principle of policy which, while not in itself in its essence an ethical rule, would enable us to judge between different ethical rules. It is for such a principle that I am searching, and which I claim to be discoverable in the notion which I have referred to as 'biological wisdom'" (Potter 1988).

Leopold, Potter, and Waddington were keenly aware that modern humans had existed on the earth for mere moments in the deep time of billions of years of other life forms. Biological wisdom, they knew, would be necessary to prolong our stay with meaningful quality. Potter said that any ethic for the human

Hippocratic Lessons

Contemporary physicians and healthcare institutions pay little attention to more general ecosystem health, even though in his famous treatise, "On Airs, Waters, and Places," Hippocrates (400 BCE) saw the connections to medicine when he wrote

> "Whoever wishes to investigate medicine properly, should proceed thus: in the first place to consider the seasons of the year, and what effects each of them produces for they are not at all alike, but differ much from themselves in regard to their changes. Then the winds, the hot and the cold, especially such as are common to all countries, and then such as are peculiar to each locality. We must also consider the qualities of the waters, for as they differ from one another in taste and weight, so also do they differ much in their qualities. In the same manner, when one comes into a city to which he is a stranger, he ought to consider its situation, how it lies as to the winds and the rising of the sun; for its influence is not the same whether it lies to the north or the south, to the rising or to the setting sun. These things one ought to consider most attentively, and concerning the waters which the inhabitants use, whether they be marshy and soft, or hard, and running from elevated and rocky situations, and then if saltish and unfit for cooking; and the ground, whether it be naked and deficient in water, or wooded and well watered, and whether it lies in a hollow, confined situation, or is elevated and cold; and the mode in which the inhabitants live, and what are their pursuits, whether they are fond of drinking and eating to excess, and given to indolence, or are fond of exercise and labor, and not given to excess in eating and drinking.

> From these things he must proceed to investigate everything else. For if one knows all these things well, or at least the greater part of them, he cannot miss knowing, when he comes into a strange city, either the diseases peculiar to the place, or the particular nature of common diseases, so that he will not be in doubt as to the treatment of the diseases, or commit mistakes, as is likely to be the case provided one had not previously considered these matters.

species has to be based on the possibility of severely degraded quality of life—even human extinction—and that each of us has the capacity to figure out how we "ought" to live, to avoid the fate of most other species (Potter 1988).

In 1978, philosopher Hans Jonas noted that modern technology has introduced actions of such novel scale, objects, and consequences that the framework of former ethics can no longer contain them (Jonas 1984). Jonas argued that, since future generations will exist, the power of our technologies and our actions to reach far into time and space is sufficient to establish a moral responsibility to future generations. This is not, he pointed out, an assertion about the rights of future generations but rather a claim about our responsibilities to them.

Much human behavior suggests that we do not recognize responsibilities to future generations or even to current generations, particularly when they live some distance from us. We continue to draw down the earth's natural capital, squander resources into scarcity, and contaminate ecosystems with untested chemicals and other industrial waste. We seem unable to recognize natural planetary limits and the need for restoration and regeneration of human life-support systems. The healthcare sector has both an opportunity and responsibility to address the ecological and bioethical dimensions of its own contributions to this trajectory as well as to influence the behavior of others.

Ecological health and disease prevention: Designing for the twenty-first century

Lee Jong-wook, who served as acting director-general of the World Health Organization from 2003 until his death in 2006, said in *Ecosystems and Human Well-Being: Health Synthesis. A Report of the Ecosystem Millennium Assessment:*

> These more distant and complex links mean that we now need to look at environmental health through a broader lens. Health risks are no longer merely a result of localized exposures to "traditional" forms of pollution—although these still certainly exist. They are also a result of broader pressures on ecosystems, from depletion and degradation of freshwater resources, to the impacts of global climate change on natural disasters and agricultural production.

> Like more traditional risks, the harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor. However, unlike these more traditional hazards, the potential for unpleasant surprises, such as emergence and spread of new infectious diseases, is much greater. This report represents a call to the health sector, not only to cure the diseases that result from environmental degradation, but also to ensure that the benefits that the natural environment provides to human health and well-being are preserved for future generations [WHO 2005].

In its 2003 report on the future of the public's health in the twenty-first century, the Institute of Medicine argued for a more integrated public health system and said

> The emphasis on an intersectoral public health system does not supercede the special duty of the governmental public health agencies but, rather, complements it with a call for the contributions of other sectors of society that have enormous power to influence health. A public health system would include the governmental public health agencies, *the healthcare delivery system,* and the public health and health sciences academia, sectors that are heavily engaged and more clearly identified with health activities. The committee has also identified communities and their many entities (e.g., schools, organizations, and religious congregations), *businesses,* employers, and the media as potential actors in the public health system. Businesses play important, often dual, roles in shaping population health. In the occupational setting, through environmental impacts, as members of communities, and as purveyors of products available for mass consumption, businesses may undermine health by polluting, spreading environmental toxicants, and producing or marketing products detrimental to health. However, businesses can and often do take steps to contribute to population health through efforts such as facilitating economic development and regional employment and workplace-specific contributions such as health promotion and the provision of healthcare benefits. The media is also featured because of its deeply influential role as a conduit for information and as a shaper of public opinion about health and related matters [emphasis added].

In planning for the twenty-first century, the healthcare sector—as institutions for healthcare delivery and as businesses—has opportunities to design their roles, services, buildings, and infrastructure intentionally within this integrated approach. The healthcare sector can be drivers of change, not only by modifying their own practices and activities, but also by helping other sectors to identify and ameliorate their contributions to impaired public environmental health and discover opportunities for positive change.

The design of the menu of services provided by healthcare institutions must logically precede the design of buildings to house them. Revisiting the nature of those services and how they are financed are certain to be at times controversial and subject to debate. Nevertheless, those services should be reviewed with full consideration of their appropriateness, the ecological context in which they are provided, their environmental impacts, and the demonstrable reality that health status in the United States is inferior to that in countries that spend far less on healthcare. Those services should also be reviewed through an expanded lens of bioethics that embraces the fundamental interconnections among individual, public, and environmental health.

Each institution, professional association, and healthcare-related business will need to address what it believes its roles and responsibilities are in disease prevention, preserving and restoring ecological services on which all life depends, and engaging with other sectors in a more integrated approach to improve public health. This will be an opportunity to decide whether to embrace the status quo or to begin to develop a new path into the twenty-first century based on current science and circumstances.

Examples of questions to consider

- What is health? What are the boundaries of the framework in which that question is considered? Why?

- How can we incorporate an expanded view of bioethics into all institutional activities?

- Some notable economists have argued that large increases in medical expenditures will serve as the engine to drive the economy and are not alarming since Americans are wealthy and need to spend their money on something (Kolata, 2006). What are the implications of this point of view for disease prevention and the environmental impacts of the healthcare sector?

- To what extent do we truly care about disease prevention? Do our activities aid or hinder disease prevention? For example, in hospitals offering weight-reduction surgery, are any steps also undertaken to address the underlying causes of obesity in the community?

- How do we encourage (or discourage) health promotion and disease prevention in individuals and in communities that we serve? In homes, schools, businesses? Are there new opportunities that we should explore? What can we do to promote community health restoration and resilience?

- Given their importance, how are we addressing the social determinants of health? How can we help to alleviate poverty and stress in our communities? What institutional services could we design into our programs to help do that?

- How are we supporting our local economy and doing what we can to keep money flowing through the local economy as long as possible?[1]

- What is the size of our environmental footprint? How can it be reduced?

- How can we reduce our use of toxic chemicals and encourage improved chemical and materials production policies in the manufacturing sector?[2]

- How can we support and promote an agricultural system that provides nutritious food with reduced ecological impacts?[3]

- How can adverse public environmental health impacts of diagnostics and therapeutics be minimized (including pharmaceutical prescribing practices)?[4]

- As a way of integrating many of the environmental factors known to influence reproductive health and childhood development, how can we help to ensure that all babies born in this community are full term, of normal weight, and receive appropriate newborn, infant, and child services?

Building design, construction, and operations can be much more meaningfully addressed after questions like these and others are discussed in an open, transparent, and inclusive process. Twentieth-century answers will result in twentieth-century buildings. They may be more energy efficient, use less water, recycle more waste, and foster greater patient satisfaction than earlier versions but still not address fundamental ethical, economic, and ecological concerns.

These basic, underlying concerns will not go away by being ignored. Jane Lubchenco (1998), president of the American Association of the Advancement of Sciences, said, "As the magnitude of human impacts on the ecological systems of the planet becomes apparent, there is increased realization of the intimate connections between these systems and human health, the economy, social justice, and national security." She called for a new social contract for science that would more adequately address the problems of the coming century than does our current scientific enterprise. The contract, she said, "should be predicated upon the assumptions that scientists will (i) address the most urgent needs of society, in proportion to their importance; (ii) communicate their knowledge and understanding widely in order to inform decisions of individuals and institutions; and (iii) exercise good judgment, wisdom, and humility."

Eight years later, the need for a new social contract for science is even more apparent. The healthcare sector could make an important contribution to this effort by re-examining its social contract with society and asking whether twentieth-century assumptions, programs, and services are adequate and appropriate for the twenty-first century. Each healthcare institution, along with the community that it serves, would do well to engage in this kind of exercise early in the process of designing for the twenty-first century—informed by what we have learned and our best predictions of what lies ahead. Otherwise, we are at risk of designing for a past that no longer exists, and institutions and buildings designed for the twentieth century are unlikely to serve us or future generations well.

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Notes

1   See, for example, Business Alliance for Local Living Economies. [Web site; retrieved 7/31/06.] http://livingeconomies.org/.

2   For example, Kaiser Permanente's Environmental Stewardship Council has approved a general policy seeking to identify and reduce or eliminate chemical hazards in products that the organization purchases for any purposes within the institution.

3   For example, Kaiser Permanente has made a systemwide commitment to improving the quality of food served to patients, staff, and visitors in its institutions, serving food produced with reduced use of pesticides, hormones, and antibiotics and supporting local agriculture through preferential purchasing and supplying space for farmers markets.

4   See, for example, http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7236 [Online document; retrieved 7/31/06.] describing Swedish efforts to reduce the discharge of pharmaceuticals into the environment. At its 2006 annual meeting, the American Medical Association agreed to work with the US Environmental Protection Agency and pharmaceutical companies to develop guidelines for physicians and the public regarding the proper disposal of pharmaceuticals. It is also worth considering the extent to which disease prevention efforts would obviate some of the need for pharmaceuticals.

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