



Toxic Reduction through Environmentally Preferable Purchasing Technical Brief

Green Guide for Health Care™ Environmentally Preferable Purchasing Credits 4.1, 4.2, and 4.3

Overview

Environmentally Preferable Purchasing (EPP) policies provide priorities and guidance for products and materials purchased and used within a health care facility. The enormous purchasing power of health care institutions coupled with the lasting relationships they establish with Group Purchasing Organizations (GPOs) provides the opportunity for the health care sector to be leaders in market transformation towards healthier products and materials, spanning everything from IV bags to interior finish materials. Health care's fundamental mission of "first, do no harm" provides an additional motivation to leverage their purchasing power towards materials and products that are healthy for people and the planet.

EPP criteria can target a wide variety of environmental and health issues. However, comprehensive EPP policies in the health care sector should, at a minimum, avoid products containing mercury and DEHP (Di Ethyl Hexyl Phthalate) and provide alternatives to natural rubber latex products, the three materials focused on in this Technical Brief.

Mercury

Mercury is a potent neurotoxin, a global priority pollutant and a PBT – a persistent bioaccumulative and toxic chemical. PBTs break down slowly in the environment, taking thousands of years in some cases. As a result, they accumulate in animal tissue in increasingly higher concentrations as they travel up the food chain. Bioaccumulation is particularly problematic for PBTs because they are extremely toxic even in small quantities. In 1998, a Memorandum of Understanding between the American Hospital Association and the U.S. EPA set goals for hospital pollution prevention, including a goal for the virtual elimination of mercury and mercury-containing devices from the hospital waste stream by the year 2005, and identified hazardous substances such as PBTs for pollution prevention and waste reduction opportunities. The MOU's stated purpose is to "provide the health care industry with enhanced tools for minimizing the production of persistent, bioaccumulative and toxic ("PBT") pollutants and reducing the volumes of waste generated. Such reductions are beneficial to the environment and will reduce the waste disposal costs incurred by the health care industry."¹

Historically, mercury has been the ideal choice for use in medical devices that measure temperature (thermometers) and pressure (sphygmomanometers), and in other applications where density and flexibility were needed (esophageal dilators). In chemicals, including pharmaceuticals, mercury has been used as a preservative. In buildings, mercury's electrical conductivity combined with its ability to flow prompted its widespread use in electrical switches and gauges, as well as fluorescent lamps. For these and many other applications, mercury-containing devices and materials have been an integral part of health care facility operations for decades. For more information about EPP practices related to mercury avoidance, see the *Green Guide for Health Care* Mercury Elimination Technical Brief.

¹ 1998 Memorandum of Understanding Between the American Hospital Association and the U.S. Environmental Protection Agency, <http://www.h2e-online.org/pubs/Memorandum.pdf>.

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

Di Ethyl Hexyl Phthalate (DEHP)

Di (2-ethylhexyl) phthalate (DEHP) is present in the health care setting as the most widely used plasticizer in medical products made from polyvinyl chloride (PVC), such as IV bags and tubing. It is also used in products as diverse as perfumes, cosmetics, building materials (such as PVC flooring, PVC wall covering and other flexible PVC finishes), and toys. The State of California lists DEHP as a reproductive toxicant, while the European Union has banned its use in children's toys. Without the addition of a plasticizer such as DEHP, the inherently brittle polyvinyl chloride polymer would be useless for flexible applications. During certain procedures, such as medications and blood transfusions introduced through a PVC medical device, DEHP can leach out and expose patients to the chemical. Exposure levels can exceed the FDA's estimated "tolerable intake," increasing the risk of harmful impacts in certain patients.

Natural Rubber Latex

Allergic sensitivity to natural rubber latex is a serious medical problem for a growing number of patients and can become a disabling occupational disease among health care workers. Allergic reactions to latex range from skin disease to asthma and anaphylaxis and can result in chronic illness, disability, career loss, hardship, and, in extreme circumstances, death. According to the U.S. Food and Drug Administration (FDA), roughly one percent of the U.S. population is believed to have a latex allergy. However, the U.S. Occupational Safety and Health Administration (OSHA) estimates that 8 to 12 percent of health care workers have developed a sensitivity to latex. Presently, there is no treatment for latex sensitized persons except complete natural rubber latex avoidance.

GGHC v2.2 Environmentally Preferable Purchasing Credit 4 offers three possible points, recognizing the importance of strong EPP policies and programs in enhancing a health care facility's performance relative to human health and environmental criteria. GGHC v2.2 Environmentally Preferable Purchasing Credit 4.1 encourages facilities to avoid mercury. GGHC v2.2 Environmentally Preferable Purchasing Credit 4.2 targets, DEHP avoidance. And, GGHC v2.2 Environmentally Preferable Purchasing Credit 4.3 suggests providing natural rubber latex-free alternatives for key medical products.

The Challenges

Mercury: Many mercury products contain a "hidden" component (switches, relays, etc.) within a larger device. As a result, purchasers may not know the products they are purchasing contain mercury. Additionally, purchasing departments may not flag these devices if they are uninformed by state and/or local laws prohibiting sale or purchase of mercury containing products.

DEHP: Viable cost-competitive alternatives to products containing DEHP are widely available. However, it is often difficult to determine whether a product contains DEHP because most DEHP-containing products are not labeled as such. Additionally, many hospitals do not keep records of which products in their facility contain DEHP. Purchasing lists often contain incomplete data, a problem exacerbated by some manufacturers' reluctance to provide material content data on a product label or in product data sheets. Many group purchasing organizations (GPOs) catering to health care facilities are beginning to provide coding indicating the presence of DEHP.

Natural Rubber Latex: Natural rubber latex exhibits high performance characteristics for a variety of medical products. Alternatives to latex products may either exhibit lower performance characteristics or contain other problematic chemicals, such as DEHP. The *Green Guide* recommends offering either gloves made from effective latex alternatives (e.g., nitrile) or low-protein, powder-free latex gloves. For other products, the *Green Guide* recommends offering latex alternatives on an as-needed basis. Some patients may be unaware of their latex sensitivity, because symptoms can manifest themselves suddenly after years of exposure.

Best Practices

Environmentally Preferable Purchasing: Perform an Audit

- 1. Begin with the purchasing/materials department.** Ask the facility's materials manager (procurement officer or resource manager) for:
 - A list of medical devices purchased by the department
 - Products on contract with the Group Purchasing Organization (GPO)
- 2. Perform a walk-through of the department.**

Carefully read the labels for chemicals of concern. Each manufacturer labels material content differently. **In most cases, products are not labeled with material content.**
- 3. Update the purchasing department list** by adding material content information for those additional products found on shelves. Include the product name, product number, product size (e.g., 8 FR, 30 cm, 22 inches), and manufacturer's name.
- 4. Fill in missing material data.** Unfortunately, many devices may not list material content.
 - *Ask the facility's GPO.* With growing concerns over exposure to mercury, DEHP, and natural rubber latex, GPOs are beginning to label products in their catalogues.
 - *Contact manufacturers directly.* With accurate product information in hand (e.g., product number, product size) and persistence material content information can be obtained from manufacturer representatives.
 - *Request help from purchasing in collecting material content information.* Purchasing works with manufacturer representatives and knows who to ask for material content information. Frame the request as a patient care issue.
- 5. Identify alternatives**
 - *Look for alternative products and manufacturers* using resources such as Health Care Without Harm (<http://www.noharm.org>) and the Sustainable Hospitals Project at the University of Massachusetts, Lowell (<http://www.sustainablehospitals.org>).
 - *Work with the facility's GPO.* Review the list of available products offered through the GPO.
 - *Contact medical device manufacturers.* Ask for Mercury-free, DEHP-free, and latex-free products that meet or exceed the same performance requirements (specifications) as the products they will replace. For example, do not replace a pediatrics product that contains DEHP with a DEHP-free product in the manufacturer's adult product line.

Mercury Elimination (GGHC v2.2 Environmentally Preferable Purchasing Credit 4.1)

Inclusion of a mercury elimination requirement in the 2006 *AIA Guidelines for Design and Construction of Health Care Facilities* reflects the health care industry's growing awareness that mercury elimination is a priority in both facility design and operations and medical care.

To assist in mercury elimination, a variety of state and local laws have required labeling of mercury-containing products, as well as prohibiting the use and/or disposal of many mercury-containing products. Legislation in this area is often spurred by local and regional concerns. As a result, facilities managers and specifications writers should research environmental non-profit organizations and regional U.S. EPA websites from their area for updates on mercury legislation.

For more information about mercury elimination in Environmentally Preferable Purchasing protocols, see the *Green Guide for Health Care* Mercury Elimination Technical Brief and the Health Care Without Harm website, <http://www.noharm.org>.

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

DEHP Elimination (GGHC v2.2 Environmentally Preferable Purchasing Credit 4.2)

The availability of DEHP-free products has increased over the past few years in response to a growing demand among health care institutions across the country. Some Group Purchasing Organizations (GPOs) now identify DEHP-free products in their catalogues.

1. *Perform a DEHP audit.* See audit information above.
 - Keywords for PVC-free products include: “EVA,” “Polyurethane,” “Silicone,” “Polypropylene,” “PVC-free.”
 - Keywords for PVC products made without DEHP include: “DEHP-free” and “TOTM” (non-DEHP plasticizer).
 - Keywords for products containing DEHP: “Contains DEHP,” “Polyvinyl chloride,” “PVC,” and “Vinyl.” Products labeled as containing PVC, but with no mention of DEHP, typically contain DEHP. Flexible plastic medical devices with no mention of material content may be made with DEHP and PVC.
2. *Identify highest risk patient populations.* The FDA identifies the following populations as high risk:
 - Male neonates
 - Pregnant women carrying male fetuses
 - Peripubertal males
3. *Identify highest risk procedures.* The FDA identifies the following procedures as high risk:
 - Total parenteral nutrition in neonates (with lipids in PVC bag)
 - Enteral nutrition in neonates and adults
 - Multiple procedures in sick neonates (high cumulative exposure)
 - Hemodialysis in peripubertal males or pregnant or lactating women
 - Exchange transfusion in neonates
 - Heart transplantation or coronary artery bypass graft surgery (aggregate dose)
 - Massive infusion of blood into trauma patient
 - Extracorporeal membrane oxygenation (ECMO) in neonates
 - Transfusion in adults undergoing ECMO
4. *Adopt a DEHP Elimination Policy*
 - Include a timeline for phase-out.
 - Include a purchasing policy that gives preference for DEHP-free products.
 - Consider non-medical sources of DEHP exposure, such as PVC resilient flooring, carpet backing, wall coverings.

Natural Rubber Latex (GGHC v2.2 Environmentally Preferable Purchasing Credit 4.3)

Latex allergies stem from two sources: sensitivity to proteins in the natural rubber (Type I) and sensitivity to chemicals produced during the manufacturing process (Type IV). Dry, itchy, irritated skin when a user comes in contact with natural rubber latex, called irritant contact dermatitis, while uncomfortable, is not a true allergy.

Type I Allergies

- This allergy, called immediate hypersensitivity, is a reaction to proteins in the natural rubber latex.
- Allergic reactions are usually immediately apparent and can be life threatening.
- *Symptoms:* hives, hay fever symptoms, asthma, anaphylaxis (in extreme cases).

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

Type IV Allergies

- This allergy, called allergic contact dermatitis, is a reaction to chemicals used during manufacturing.
- The allergic reaction is generally delayed 6 to 48 hours after exposure.
- *Chemicals that commonly cause reactions:* thiurams, dithiocarbamates, mercaptobenzothiazoles (MBT).
- *Symptoms:* a red, itchy, scaly rash that is usually localized on the wrists and forearms.

At Risk Populations

- Individuals exposed to latex on a regular basis due to their occupation: Health care workers, car mechanics, food service workers, etc.
- Patients undergoing multiple medical procedures.
- Individuals with known food allergies.
- Individuals with atopic allergic disease.

As recognition of latex allergies has grown, so has the development of latex-free alternatives. Nitrile, neoprene, and PVC gloves are now widely used. The *Green Guide* does not recommend replacing latex gloves with neoprene or PVC in facilities interested in eliminating chlorinated plastics – see the *Green Guide for Health Care* PBT Elimination Technical Brief for further discussion. Mylar balloons in lieu of latex balloons are increasingly commonplace.

The following medical products often contain natural rubber latex:

Common Medical Devices	Anesthesia and Operating Room Equipment	Miscellaneous Products
Adhesive tape	Blood pressure cuffs	Adhesive tape
Band-Aids and similar	Chest drainage units	Balloons
Bulb syringes	Drapes	Condom
Colostomy pouch	Endotracheal tubes	Camera eyepiece
Condom urinary collection devices	Epidural catheter injection adapters	Diaphragm
Dental cofferdams	Eye shields	Dummies
Elastic bandages	Injection ports on iv bags	Household work gloves
Enema tubing kits	Latex cuffs on plastic	Paint
Fluid warming blankets	Latex injection ports on iv tubing	Raincoats
Gloves - examination and sterile	Multidose vial stoppers	Shower cap
Haemodialysis equipment	Naso-pharyngeal airways	Tennis/squash shoes
Mattresses on stretchers	Rubber ventilation bellows	Underwear
Neonatal incubator	Rubber masks	
Rubber pads	Rubber tourniquets	
Stethoscope tubing	Surgical masks	
Stomach and GI tubes	Teeth protectors & Bite blocks	
Tourniquets		
Urinary catheters		
Wound drains		

Latex-free alternatives are widely available for the following products:

- Gloves
- Perioperative supplies

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

- Respiratory supplies (masks, lumens, cannulas, tubing, connectors, vent circuits, resuscitators, trach tubes and care kits, asthma supplies)
- Wound care

Substitution Strategies

1. *Develop a purchasing policy that provides alternatives to latex products.*
 - Audit all stakeholders, especially nursing staff, to determine products that require substitutes.
 - Audit the facility for all latex or latex-containing products.
 - Incorporate latex-free alternatives into the facility's purchasing protocol.
 - Latex products that are purchased should be low-protein (<50 mcg/g) and powder-free.
 - Store the most frequently requested latex-free products, especially gloves, in an easily accessible location.
2. *Prioritize strategies for latex gloves.* Natural rubber latex gloves represent the largest volume of latex medical products in use.
 - Provide either gloves made from effective latex alternatives (e.g. nitrile) or low-protein, powder-free latex gloves.
 - If an employee becomes sensitized to latex, he/she should never personally use latex, and co-workers should not use latex gloves. The employee should wear a Medic Alert bracelet. If the employee has an allergic reaction to latex, he/she should be provided a latex-safe or latex-free area in which to work.
 - High-risk employees should be regularly monitored for symptoms using a questionnaire or other procedure.
 - Ask patients whether they have experienced a latex allergy in the past. Provide patients who have a history of latex allergy or who become sensitized with a latex-safe or latex-free environment.
 - If a natural rubber latex allergy requires use of a non-latex alternative, verify that the substitute provides a level of protection appropriate to the medical procedure. Some non-latex gloves do not offer sufficient protection against blood-borne pathogens. Others do not offer sufficient protection against some chemicals.
3. *Training and Education*
 - Establish regular training sessions that cover the details of the purchasing policy and the location of latex-free supplies.
 - Teach staff to recognize symptoms of latex sensitivity on patients and on themselves. Establish clear protocols for diagnosis and treatment following an initial observation of sensitivity.
 - Provide information to patients and visitors on the facility's latex policy and the protocol for requesting replacement products.

Furnishings and Finishes

Natural rubber latex is used in medical furnishings and permanent finishes, such as carpet backing, cart tires/casters, and mattresses. Due to the performance characteristics of low-protein natural rubber latex, it is generally cost prohibitive and not recommended to eliminate all latex from a health care facility. However, the facility should employ steps to minimize airborne latex contamination. Hard rubber latex products are less likely to release airborne latex proteins than stretchy products.

Benefits

Health

Mercury: When mercury enters water, biological processes convert it into methylmercury, a chemical that is highly toxic to humans. According to the U.S. EPA, human exposure in the United States is largely attributed to fish consumption. Almost all humans contain at least a trace amount of methylmercury in their systems. Once inside the body, mercury is slow to pass out of the system. However, methylmercury passes across the placenta with ease, creating conditions that could potentially harm the development of a fetus's brain and nervous system. In large doses, methylmercury can reach a harmful level of toxicity in adults, as well.

DEHP: Humans are exposed to DEHP via leaching out of a PVC product into a fluid or directly into the bloodstream, dust, and food. A growing body of research has found that DEHP harms the reproductive systems of human infants, particularly males. Studies of rodents have shown that DEHP causes a range of developmental and reproductive effects on males when it is introduced in the womb or shortly after birth. For this reason, products containing DEHP should be avoided in particular when treating male neonates, pregnant women carrying male fetuses, and peripubertal males. DEHP can also damage the liver, kidneys, and lungs. DEHP has also been linked to asthma in some studies.

Natural Rubber Latex: Sensitivity to natural rubber latex is a major contributor to occupational asthma, dermatitis, and other skin irritations. Up to 30 percent of health care providers develop contact dermatitis to latex during the course of their work; however, this irritation can be abated by providing sensitized individuals with alternatives to latex gloves. According to the Medical College of Wisconsin, about 50 percent of health care workers who are allergic to latex also suffer from asthma. In many cases, substituting low-protein and powder-free latex gloves will greatly reduce asthma inflammation among this population. A latex sensitivity related to continuous exposure, such as in an occupational setting, never entirely disappears. As a result, health care providers who are particularly sensitive may be forced to change profession if their asthma and environmental stimuli are not controlled.

Ecologic

Mercury: Mercury converts from a liquid to a gas at room temperature. Once airborne, it enters water sources through rain, dust, or gravity where it is transformed into methylmercury, which accumulates in fish and other animals farther up the food chain. Contamination has been known to reach levels toxic enough to cause mortality. Even small concentrations have been shown to reduce the animal's fertility, slow development, and cause abnormal behavior that compromises the animal's survival instincts. The mercury that contaminates U.S. rivers, lakes, and oceans is generated locally, nationally and internationally. Because it is carried on the wind as a gas, mercury is difficult to contain after it has been emitted into the atmosphere.

DEHP: Similar to mercury, phthalates such as DEHP are persistent bioaccumulative toxic chemicals (PBTs), which do not break down easily in the environment. Studies have measured alarming levels of phthalates in virtually all fresh water and marine environments, including Antarctic pack ice. Because of their resistance to decomposition, phthalates are best controlled at their source: product manufacturing. Establishing a DEHP-free policy will help reduce the amount of phthalates released into the environment.

Natural Rubber Latex: Natural rubber latex is a renewable resource that, if raised and harvested according to sustainable guidelines, offers an advantage over the many synthetic materials that dominate health care construction and medical products. Additionally, some alternatives to natural latex products, including PVC and neoprene, raise environmental health concerns associated with their manufacture, chemical leaching during use, and their ultimate disposal. As a result, EPP protocols addressing alternatives to natural rubber latex should favor materials that have other EPP attributes, as with nitrile.

Economic

Mercury: Alternatives to mercury-containing devices in the health care setting are increasingly available as competitively priced options. Mercury waste is regulated under the Resource Conservation Recovery

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

Act (RCRA), which covers the handling and disposal of all hazardous waste. Failure to meet RCRA requirements can result in up to a \$25,000 fine per day, in addition to the cost of properly disposing of hazardous waste. Eliminating mercury from a hospital setting is an effective way to limit liability and to stay one step ahead of mercury-elimination regulations at all levels of government.

DEHP: Most viable alternatives to DEHP medical devices and products do not cost more than their DEHP counterparts. As public concern about DEHP and scientific research progresses, health care facilities that institute a DEHP-free policy will avoid future liability concerns.

Natural Rubber Latex: Nitrile gloves, the most effective alternative to latex gloves, were initially more expensive than latex, but the cost has come down in most markets. Facilities that choose to stock this kind of glove should work through their purchasing department and GPO to negotiate a competitive price.

Case Studies

Miller Children's Hospital, Long Beach, CA

(For more information, visit Health Care Without Harm,
<http://www.noharm.org/details.cfm?ID=812&type=document>)

Miller Children's Hospital (MCH), located in Long Beach, CA, was founded in 1970 as part of Long Beach Memorial Medical Center. With nearly 200 inpatient beds (69 in the Neonatal Intensive Care Unit), 500 physicians, and 1,200 employees, Miller Children's is a full-service hospital and health system. Each year, approximately 5,000 children are admitted to MCH, 1,000 of whom are treated in the NICU.

Arthur A. Strauss, M.D., is Medical Director of Miller Children's Hospital NICU. After community advocates and experts alerted Dr. Strauss to the potential threats to neonate health posed by di(2-ethylhexyl) phthalate (DEHP) in January 2002, he created a proposal to eliminate DEHP containing products, which was subsequently approved and endorsed. Because numerous scientific studies show that total parenteral nutrition (TPN) bags and tubing pose the highest risk of DEHP exposure to neonates, the central supply coordinator reviewed Miller's current TPN set-up and conducted a cost analysis to estimate how much it would cost to eliminate DEHP-containing TPN products. After discovering that the TPN bags in current use are already DEHP-free, the coordinator identified IV sets as the first priority products to eliminate. The total projected cost for the switch away from DEHP IV sets was \$20,000, or approximately \$20 per patient. Other medical devices, such as endotracheal and gavage tubes containing DEHP, were placed on a list to be evaluated for elimination depending on availability of alternatives from suppliers.

A NICU DEHP elimination plan has since been introduced throughout Memorial Care's entire system, via its Best Practice NICU team. The plan will be used to demonstrate a new patient safety initiative for JCAHO, and Memorial Care is currently studying options for complete replacement of DEHP products system-wide.

Consorta / Group Purchasing Organization

(For more information, visit: http://www.consorta.com/wings/resource_mgmt/epp/)

Consorta, the U.S. fourth largest group purchasing organization (GPO), has responded to client interest over the past few years by providing a database that identifies products that contain latex, mercury, PVC, and DEHP. In addition, Consorta's website includes a section outlining recommended strategies for natural rubber latex allergy risk reduction. In an interview published in *Materials Management Magazine* (December 2005), Consorta President and CEO, John Strong, emphasized that his clients' desire for environmentally preferable products is linked to their mission of community stewardship. According to Strong, Catholic health systems are leaders in environmentally preferable purchasing (EPP). Close to 70 of Consorta's contracts specify EPP for at least some products. Consorta prioritizes green suppliers over their conventional competition if they meet all of Consorta's other criteria, such as robust distribution

Green Guide for Health Care™ Technical Brief

Toxic Reduction through Environmentally Preferable Purchasing

networks. Consorta's support of environmentally preferable purchasing has led to its being named a Champion for Change by Hospitals for a Healthy Environment (H2E) four years running (2004-2007).

Resources

In addition to the resources noted in the Green Guide for Health Care, the following may offer additional guidance:

American College of Allergy, Asthma & Immunology *Guidelines for Management of Latex Allergies and Safe Latex Use in Healthcare Facilities*, <http://www.acaai.org>, 847 427-1200.

American Nurses Association, *Latex Allergy: Protect Yourself, Protect Your Patients*, <http://www.nursingworld.org/osh/wp7.htm#10>

Association of periOperative Registered Nurses Latex Guideline, <http://www.aorn.org/about/positions/pdf/7c-latex-2004.pdf>

Health Canada, http://www.hc-sc.gc.ca/dhp-mps/prodpharma/index_e.html.

Health Care Without Harm, *Case studies of facilities that have eliminated DEHP containing medical devices*, <http://www.noharm.org/pvcDehp/reducingPVC#case>.

Health and Safety Executive of Great Britain, <http://www.hse.gov.uk/latex/index.htm>.

Mayo Clinic, <http://www.mayoclinic.com/health/latex-allergy/DS00621>

Medical College of Wisconsin, <http://healthlink.mcw.edu/article/996373507.html>

The National Toxicology Program (NTP), Center for the Evaluation of Risks to Human Reproduction (CERHR), <http://cerhr.niehs.nih.gov/>.

Sustainable Hospitals Project, University of Massachusetts at Lowell, listing of DEHP free medical products and other healthcare resources, <http://www.sustainablehospitals.org>

U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), <http://www.osha.gov/SLTC/latexallergy/>

U.S. Food and Drug Administration, <http://www.fda.gov/>.

U.S. National Institute of Occupational Safety and Health (NIOSH), <http://www.cdc.gov/niosh/latexalt.html>

Tech brief authored by Jamie Harvie, PE, of Institute for a Sustainable Future with assistance from Adele Houghton, AIA, Green Guide for Health Care, and Gail Vittori, Center for Maximum Potential Building Systems. Reviewed by Marion Congdon, American Nurses Association, and Julie Silas, Healthy Building Network.

Last update 6/29/2007.