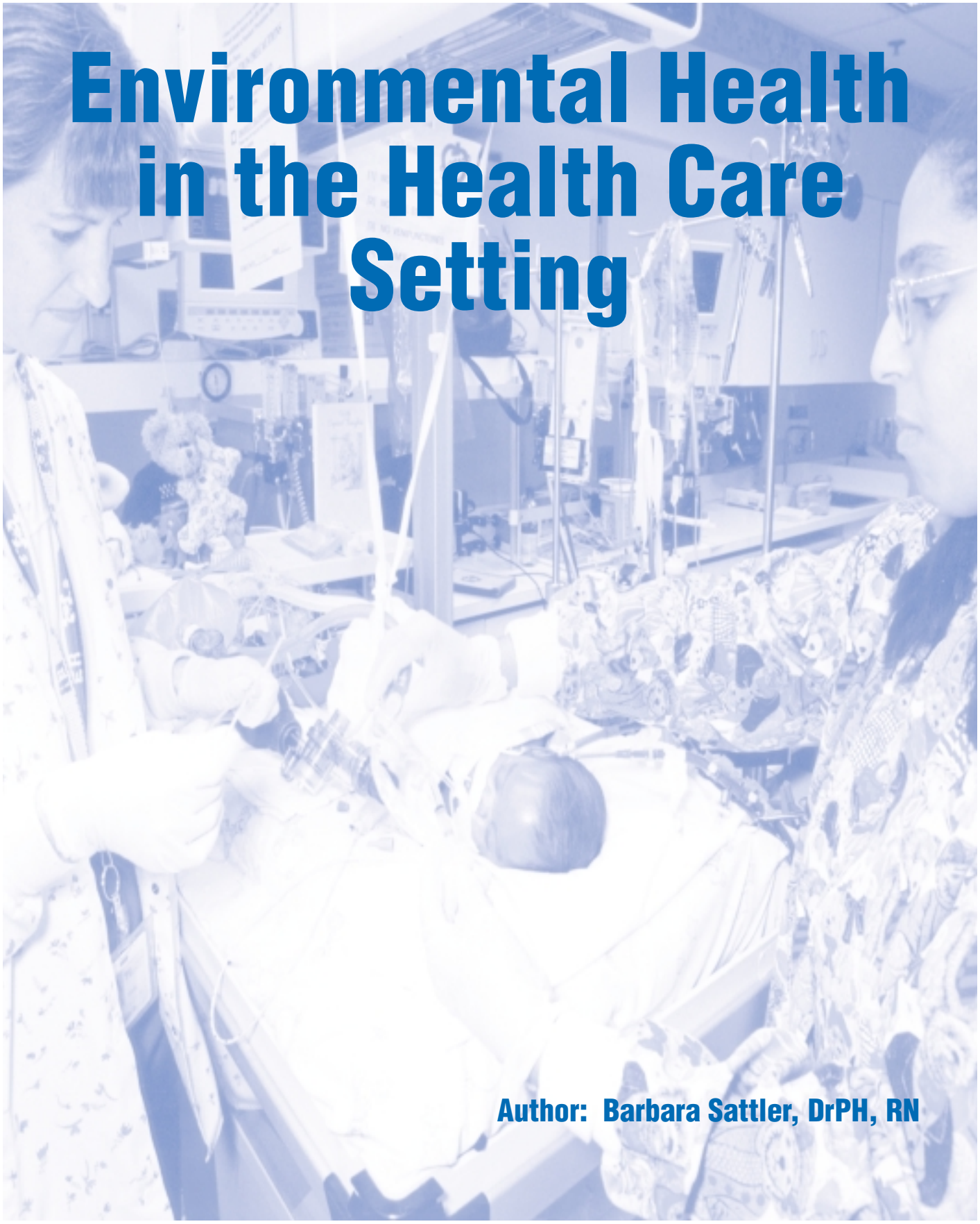
Environmental Health in the Health Care Setting



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Abstract

The health care industry is a major contributor to environmental pollution. Through the processes of waste disposal, including incineration, the health care industry is one of the largest contributors to environmental dioxin and mercury. Mercury contamination of our waterways has created the conditions by which a significant number of fish are sufficiently mercury-laden so as to pose a human health threat. Additionally, there are products and processes within the hospital that create health risks for the patients and health care staff. There are a number of positive actions that nurses can take to address the health threats posed by these exposures. These actions include: purchasing environmentally preferable products, implementing pollution prevention actions within the health care setting, and learning more about environmental health.

Objectives

1) Describe the major environmental health threats posed by the health care sector.
2) Identify three chemicals that may affect children's environmental health associated with the health care sector.
3) Explain the nurse's role in taking action to improve the environmental health risks in the health care sector.
4) Specify three resources that can provide more guidance in improving environmental health in the health sector.
5) Discuss the goals of the ANA Resolution on Pollution Prevention.
6) Describe two products/processes that are employed in hospitals which create health risks.
7) List three health effects associated with incineration.
8) Name three indicators of children's health that may be related to environmental health risks.

Environmental Health in the Health Care Setting

Introduction

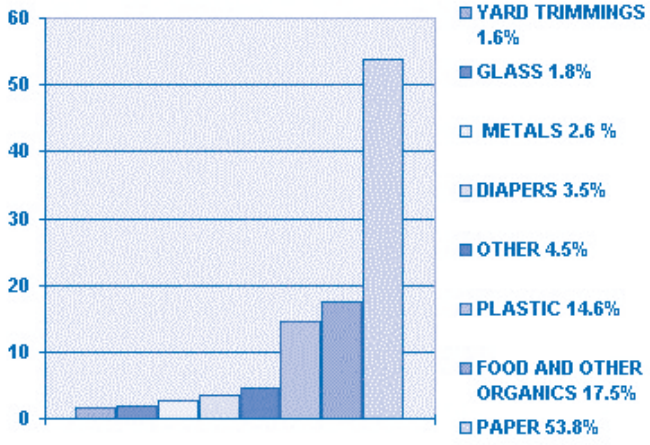
As nurses, we have chosen a health-promoting and healing profession and have elected to care for individuals, their families, and whole communities. We incorporate the risks posed by our patients' and their communities' environments into our nursing assessments, develop strategies to reduce risks and prevent disease, and advocate for their well-being. We often focus on the most vulnerable populations—the very young, the very old and frail, the sick. We would never intentionally place our charges in harm's way, and yet several of the elements of our current health care delivery system are indeed placing our most vulnerable populations at risk.

Annually, 2.4 million tons of hospital waste are generated in the United States (Rutula, 1992). Contrary to popular belief, non-hazardous medical waste makes up nearly three-fourths of the waste generated in a hospital.

In many hospitals, *all* waste is thrown into "red bags," which are subsequently incinerated, either on- or off-site. This indiscriminant process of medical waste incineration is making a dreadful contribution of toxic chemicals to our environment, resulting in health risks to us all. This health care process contradicts our professional calling as healers and protectors of health. Fortunately, there are many actions that we, as nurses, can take to stem the tides of this unfortunate development.

The profligate use of "red-bagging" was in part a result of the concerns that developed in the beginning stages of our awareness about HIV/AIDS. Out of early ignorance regarding HIV/AIDS transmission, and in an effort to reduce the handling of any and all hospital-related waste, all waste was thrown directly into a red bag and treated as though it was highly infectious. Although our understanding about HIV/AIDS transmission has progressed significantly, our misdirected "red-bagging" practices continue. The vast majority of hospital waste is the same type of waste that would be found in a household or hotel.

The content of our red bags includes paper, plastics, and heavy metals (especially mercury-containing products), as well as construction debris, pharmaceuticals, and potentially infectious waste. Only a very small amount of hospital waste cannot be recycled or sent to a municipal landfill. However, in many hospitals, *all* of the waste is sent to an incinerator, either on- or off-site. The process of incinerating hospital waste creates pollution, with two particularly worrisome pollutants—dioxin and mercury. Dioxin, a known carcinogen, poses a host of health problems as it is bioaccumulated in the environment and eventually consumed by people. Mercury has already sufficiently accumulated in our waters that it has made some fish dangerous to eat in even modest quantities. The health effects of dioxin and mercury will be further explored in this module, as will the effects of DEHP (di(2-ethylhexyl)phthalate), a chemical that is used in many of the plastic products found in health care.



Extracted from a table in the California Business Waste Reduction Program.
See: *http://www.ciwmb.ca.gov/bizwaste/factsheets/hospital.htm.*

It is important to note how we begin to understand the relationship between environmental chemical exposures and their potential for harm. There are several ways in which we have historically made such discoveries:

- When humans present signs and symptoms that can be connected to a specific chemical exposure. This has most commonly occurred when workers have been occupationally exposed. In such instances, the temporal and geographic relationships to the exposures and health effects have helped to identify health hazards.
- When large, accidental releases of chemicals have befallen a community and contaminated its air or water and this has resulted in health effects. When this has occurred, we have learned about the chemicals' toxicity to humans, as well as to other species in the environment.
- In rare instances, when human environmental (and occupational) epidemiological studies have been performed and shown associations. Through such studies, we have learned about the toxic effects of chemicals.

However, the most common way in which the relationships between chemical exposures and health risks are posited is when toxicologists study the effects of chemicals on animals and we then estimate what the effects might be on humans. This estimation process is called "extrapolation." There have been over 100,000 man-made chemical compounds developed and introduced into our environment since WWII; we are most often reliant on the data that is created in animal studies to warn us about their

potential toxicity to humans. For many of these chemicals, no toxicity data is available.

Astute observers of nature, such as Rachel Carson, the biologist and author of *Silent Spring*, have helped us to understand that the birds, reptiles, fish, and rodents in nature can sometimes be the harbingers of warning regarding hazardous chemicals. In 1962, Carson alerted the world to the harmful effects of pesticides on wildlife reproduction. It was through Carson's specific observations regarding the use of DDT (a pesticide) and its associated negative effects in nature that its toxicity to humans and others was brought to light, resulting in its ban from use in the United States. In this study module, you will learn about DEHP, a chemical found in many of the plastics that we use in health care—a chemical about which we should be heeding new warnings, including concerns about male reproduction.

With thousands upon thousands of chemical compounds now creating a chemical soup in our air and water (and in our bodies, in our breast milk), it is increasingly difficult to prove specific hypotheses regarding the relationship of exposure to a singular chemical and disease outcomes in humans. It has been suggested that we adopt a "precautionary approach" when animal research and other indicators demonstrate a possible toxic relationship between a chemical and health effect. (See box on "Wingspread Statement on the Precautionary Principle.") This "precautionary approach" calls for action to reduce potentially toxic exposure to humans in light of data or other indicators, rather than delaying until more "conclusive" studies are performed.

When there is evidence for serious, widespread, and irreversible harm, residual scientific uncertainties should not be used to delay precautionary actions. Actions should include reduction and/or elimination of exposures, as well as continued scientific investigation. As nurses who are trained in disease prevention, we can appreciate and should advocate for a precautionary approach when it may prevent injuries or illnesses.

There is a substantial body of compelling scientific evidence regarding human health threats associated with mercury and dioxin, two major pollutants emitted by the health care industry. It is recommended by the ANA that action be taken in response to this knowledge. This independent study module concurrently provides information regarding critical environmental indicators in health care and presents actions that nurses can take, individually and collectively, to turn the tides on several critical environmental health conditions. Additional resources will be presented throughout the module to guide the reader to sources for further exploration and more explicit direction.

Nurses can play a key role in affecting occupational and environmental health choices in the health care sector. An explanation of preferred practices will be offered regarding health care purchasing, waste management, and waste disposal choices. National and international initiatives to reduce pollution in the health care industry will be described including the American Nurses Association's efforts, the Environmental Protection Agency's efforts with the American Hospital Association, and the national and international efforts of the Health Care Without Harm Campaign.

This independent study module will also explore some of the unintentional, yet often avoidable, environmental health risks posed by the health care industry. It will also explore some of the specific health risks to our children, elucidating some current trends in environmentally-related exposures and diseases outcomes. Human health effects associated with select chemicals will be outlined, with a focus on mercury, DEHP, and dioxin.

Wingspread Statement on the Precautionary Principle

In 1998, an international group of health and public health professionals, scientists, government officials, lawyers, grass-roots activists, and labor activists met at a conference center called "Wingspread" in Wisconsin to define the "precautionary principle." The group issued the following consensus statement:

"The release and use of toxic substances, the exploitation of resources, and physical alterations of the environment have had substantial unintended consequences affecting human health and the environment. Some of these concerns are high rates of learning deficiencies, asthma, cancer, birth defects and species extinctions, along with global climate change, stratospheric ozone depletion and worldwide contamination with toxic substances and nuclear materials.

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment—the larger system of which humans are but a part.

"We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

"While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

"Therefore, it is necessary to implement the Precautionary Principle: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.

"The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action." [End of statement.]

(See: *http://www.gdrc.or g/u-gov/precaution-3.html.*)

Children's Environmental Health

We are slowly becoming increasingly sophisticated in our knowledge regarding the health effects associated with exposures to hazardous chemicals. Years ago, we had fairly blunt indicators such as whether or not a chemical exposure could cause an acute effect or perhaps whether or not it might cause cancer. Generally speaking this knowledge was limited to health effects in adult males. However, in the last couple of decades, many more scientists have been expanding their exploration to evaluate the relationship between exposures in women, including pregnant women, and to humans during all of their stages of development, including embryonic and fetal development, early childhood, and adolescence. We have learned that toxic chemicals can have different effects depending on the timing of exposure. Fetuses and children have particular vulnerabilities to toxic chemicals.

During fetal development, there are periods of exquisite sensitivity to the effects of toxic chemicals. At such times even extraordinarily small exposures can prevent or change a process that may permanently affect normal development. The fetal brain undergoes rapid structural and functional changes during late pregnancy and in the neonatal period. Developmental toxicants such as lead, mercury, and pesticides (all found in hospitals and their waste streams) can directly interfere with the processes required for normal brain development.

Children are more vulnerable to many of the toxic chemicals that comprise our air and water pollution. Because children eat more, drink more, and breathe more per body weight than do adults, they receive higher doses of the contaminants that are found in our food, water, and air. They are also generally less efficient at metabolizing toxic chemicals, and therefore the residence time of the toxic chemicals in their bodies is longer. Children's neurological systems continue to mature for a long time after birth, and their reproductive systems go through dramatic changes during certain stages of development, thus creating added vulnerabilities to these systems. Research on the differential impact that most environmental pollutants have on children is still quite sparse. In this study module, dioxins, mercury, and DEHP have been chosen for elaboration because the scientific evidence indicates a clear differential effect on our children's health.

A number of indicators reveal that problems in child development are on an upward trend. In the United States, 17% of our children suffer from one or more developmental disabilities (Boyle, 1994). Learning disabilities alone may affect 5-10% of children in public schools (American Psychiatric Association, 1994). In the United States, 1.5 million children are taking Ritalin, 1% of all children are mentally retarded, and the increase in the prevalence of autism is up 200% in the last two decades. Over a 12-year period, childhood bone cancers have increased 40% in boys and 33% in girls, and childhood brain cancer has increased 24% in boys and 19% in girls. Since 1960, the incidence of undescended testes and hypospadias has doubled (ANA publication—"Sample Presentation" in the Pollution Prevention Kit). Although chemical pollutants certainly do not contribute to the whole of this trend, the scien-

tific evidence that they make a contribution is strong.

Dioxin and mercury are pollutants from the health care industry, and pesticides are routinely used in most hospitals. Primates exposed to dioxin as fetuses show evidence of learning disabilities. Likewise in a tragic incident of mercury exposure to pregnant women in Japan, children were born severely mentally retarded and with impaired gaits and visual disturbances. A recent five-year study of pesticide exposures suggests that combinations of commonly used agricultural chemicals, in levels typically found in ground water, can significantly influence immune and endocrine systems, as well as neurological function, in laboratory animals (Schettler et al., 2000).

Of the top 20 pollutants reported to the EPA, through the Toxic Release Inventory in 1997, nearly three-quarters are known or suspected neurotoxicants (Schettler et al., 2000). Medical waste incinerators contribute to this list of environmental neurotoxicants when they release mercury, lead, cadmium, and dioxin.

Of the tens of thousands of man-made chemicals that are in commerce today, the EPA has only been able to complete toxicity testing on a small number of them. Right now the EPA is working with industry to test some 2,000 of the highest production volume chemicals. To make things even more complicated, risks from *multiple* chemical exposures are rarely considered when research is designed or regulations drafted. Such an omission ignores the reality that children (as well as adults) are exposed to many toxic chemicals, often concurrently.

(A rare regulatory exception to this rule is the case of regulations for pesticides that are used on food. This exception was created by the 1996 Food Quality Protection Act, in which Congress acknowledged that children eat more than one type of food that may contain pesticides, thus creating the risk of more than one pesticide exposure at any given time. Additionally, children tend to eat much more fruit and drink more fruit juices than adults, thus further increasing their exposure to pesticide residues. For more information on the Food Quality Protection Act, see: *www.epa.gov/opppsps1/fqpa*.)

Children have unique vulnerabilities to most chemicals and specifically to the three chemicals emphasized in this study module: mercury, DEHP, and dioxin.

Environmental Health Risks in the Health Care Setting

Mercury

Mercury is an element that has many uses and which becomes a toxic pollutant in a variety of ways. Methylmercury, the form mercury often takes in the environment, is toxic to human nervous systems and immune systems and creates a risk for hypertension and renal damage. Animal studies, including non-human primates, have found reproductive problems including decreased conception rates, early fetal loss, and stillbirths (Burbacher et al., 1988). Based on human exposures, there is suggestive evidence of a negative effect on human fertility (National Research Council, 2000). The largest contributors of mercury in our environment are the coal-fired power plants (in which naturally-occurring mercury is found in coal and released into the atmosphere when the coal is burned) and municipal and medical waste incinerators (when mercury-containing products are burned). Mercury contamination in the health care industry comes from the incineration of some of the products listed in the box below.

Mercury may exist in a number of different chemical forms but usually is released into the environment as a metal or an inorganic compound. When it is dispersed into the atmosphere, it can travel widely to all reaches of the earth, and when it lands on a body of water, it is converted by bacteria into methylmercury, an organic form that is highly toxic. Organic mercury is the most dangerous form of mercury because, like many environmental toxicants, it crosses into the brain and into the fetus so easily.

Mercury contamination of our waterways is now so severe that over 40 states have issued health advisories warning pregnant women or women of reproductive age to avoid or limit fish consumption. To find out about the specific fish advisories in your community, see *www.epa.gov/ost/fish*. A drop of mercury as small as 1/70 of a teaspoon can contaminate a 25-acre lake to the point that the fish will be unsafe to eat (Thompson and Erickson, 1999). Alarmingly, ten states have issued advisories for every lake and river within their state's borders.

According to the EPA, over 1 million women in the United States of childbearing age eat sufficient amounts of mercury-contaminated fish to risk damaging brain development in their children (NRC, 2000). The National Academy of Science report on methylmercury states that "over 60,000 newborns annually might be at risk for adverse neurodevelopmental effects from in utero exposure to MeHg [methylmercury]" based on consumption of mercury-contaminated fish (NRC, 2000).

Nurses need to understand the implications that the fish advisories have for their patients and communities and the contribution that the health sector has in creating this health risk.

Mercury-Containing Products

Equipment	Use
Batteries Mercuric Oxide	Hearing Aids Pacemakers Defibrillators Fetal Monitors Hofler Monitor Pagers Picker Caliber Spirometer Alarm Telemetry Transmitter Temperature Alarm Blood Analyzer
Thermometers	Temperature Measurement
Sphygmomanometers	Blood Pressure
Barometers	Weather Conditions
Esophageal Dilators Cantor Tubes Miller Abbot Tubes Feeding Tubes	Hg is used as weight at the bottom of the tubes.
Electrical Instruments	Laboratory Ovens (including Microwave Ovens) Nursing Incubators Room Temperature Controllers Refrigerators Relays Switches (no-noise switch used in patient rooms)
Lamps	Fluorescent Lamps Metal Halide Lamps High Pressure Sodium Lamps Ultraviolet Lamps Cathode Ray tubes
Analytical Instruments using mercury chloride as reagent	Sequential Multiple Analyzer (SMAC) AU 2000
Electron Microscope	Mercury used as vibration damper.

(For this chart and more information on mercury use in health care, including a helpful virtual tour of the hospital for sources of mercury, see: *www.epa.gov/seahome/mercury/src/outmerc.htm*.)

FDA's Fish Advisory

CONSUMER ADVISORY

Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration
March 2001

AN IMPORTANT MESSAGE FOR PREGNANT WOMEN AND WOMEN OF CHILDBEARING AGE WHO MAY BECOME PREGNANT ABOUT THE RISKS OF MERCURY IN FISH

Seafood can be an important part of a balanced diet for pregnant women. It is a good source of high quality protein and other nutrients and is low in fat.

However, some fish contain high levels of a form of mercury called methylmercury that can harm an unborn child's developing nervous system if eaten regularly. By being informed about methylmercury and knowing the kinds of fish that are safe to eat, you can prevent any harm to your unborn child and still enjoy the health benefits of eating seafood.

HOW DOES MERCURY GET INTO FISH?

Mercury occurs naturally in the environment and it can also be released into the air through industrial pollution. Mercury falls from the air and can get into surface water, accumulating in streams and oceans. Bacteria in the water cause chemical changes that transform mercury into methylmercury that can be toxic. Fish absorb methylmercury from water as they feed on aquatic organisms.

HOW CAN I AVOID LEVELS OF MERCURY THAT COULD HARM MY UNBORN CHILD?

Nearly all fish contain trace amounts of methylmercury which are not harmful to humans. However, long-lived, larger fish that feed on other fish accumulate the highest levels of methylmercury and pose the greatest risk to people who eat them regularly. You can protect your unborn child by not eating these large fish that can contain high levels of methylmercury: Shark, Swordfish, King mackerel and Tilefish.

While it is true that the primary danger from methylmercury in fish is to the developing nervous system of the unborn child, it is prudent for nursing mothers and young children not to eat these fish as well.

IS IT ALL RIGHT TO EAT OTHER FISH?

Yes. As long as you select a variety of other kinds of fish while you are pregnant or may become pregnant, you can safely enjoy eating them as part of a healthful diet. You can safely eat 12 ounces per week of cooked fish . A typical serving size of fish is from 3 to 6 ounces. Of course, if your serving sizes are smaller, you can eat fish more frequently. You can choose shellfish, canned fish, smaller ocean fish or farm-raised fish—just pick a variety of different species.

WHAT IF I EAT MORE THAN 12 OUNCES OF FISH A WEEK?

There is no harm in eating more than 12 ounces of fish in one week as long as you don't do it on a regular basis. One week's consumption does not change the level of methylmercury in the body much at all. If you eat a lot of fish one week, you can cut back the next week or two and be just fine. Just make sure you average 12 ounces of fish a week.

Some kinds of fish are known to have much lower than average levels of methylmercury and can be safely eaten more frequently and in larger amounts. Contact your federal, state, or local health department or other appropriate food safety authority for specific consumption recommendations about fish caught or sold in your local area.

WHAT ABOUT THE FISH CAUGHT BY MY FAMILY OR FRIENDS IN FRESH WATER LAKES AND STREAMS? ARE THEY SAFE TO EAT?

There can be a risk of contamination from mercury in fresh waters from either natural or industrial causes that would make the fish unsafe for you or your family to eat. The Environmental Protection Agency provides current advice on fish consumption from fresh water lakes and streams. Also check with your state or local health department to see if there are special advisories on fish caught from waters in your local area.

For information about the risks of Mercury in Seafood, call toll-free 1 (888) SAFEFOOD
U. S. Food and Drug Administration
Center for Food Safety and Applied Nutrition
Food Information Line 24 hours a day
Or Visit FDA's Food Safety Website
www.cfsan.fda.gov

FURTHER INFORMATION IS ALSO AVAILABLE: Environmental Protection Agency
www.epa.gov/ost/fish

EPA's Fish Advisory

United States Environmental Protection Agency
Office of Water
4301
EPA-823-F-01-004
January 2001

National Advice on Mercury in Fish Caught by Family and Friends: For Women Who Are Pregnant or May Become Pregnant, Nursing Mothers, and Young Children

Summary

EPA is issuing a national advisory concerning risks associated with mercury in freshwater fish caught by friends and family. The groups most vulnerable to the effects of mercury pollution include: women who are pregnant or may become pregnant, nursing mothers, and young children. To protect against the risks of mercury in fish caught in freshwaters, EPA is recommending that these groups limit fish consumption to one meal per week for adults (6 ounces of cooked fish, 8 ounces uncooked fish) and one meal per week for young children (2 ounces cooked fish or 3 ounces uncooked fish).

(To get more information on EPA's fish advisory program, visit EPA's fish advisory Web site at *www.epa.gov/ost/fish/* or contact Jeff Bigler at 202-260-1305; e-mail: bigler.jeff@epa.gov.)

Methylmercury bioaccumulates in the food chain, magnifying in dose as it goes up the food chain to larger and larger species. Humans typically eat fish that are high on the aquatic food chain, resulting in high mercury contamination. "There are extensive data on the effects of MeHg [methylmercury] on the development of the brain (neurodevelopmental effects) in humans and animals" (NRC, 2000). Through two tragic environmental exposures in human populations, we have first-hand knowledge of both the acute and chronic effects of methylmercury poisoning.

In the 1950s, in Japan, Minamata Bay was severely contaminated with mercury from an industrial plant. Although the women in the area showed no symptoms, the children born to the women developed a heartrending array of developmental symptoms including mental retardation, disturbances of gait, speech, sucking and swallowing, and abnormal reflexes (Harada, 1978). In another instance, in Iraq in the 1970s, where bread was baked with grain that had been sprayed with organic mercury as a pesticide to treat fungus, acute symptoms included visual disturbances, with blindness in several instances. The effect on children born to poisoned mothers was psychomotor retardation with delays in walking and increased incidence of seizures (Amin-Zaki, 1976).

When there is a mercury spill in a hospital room, the indoor air can become contaminated. "If mercury is inhaled, as much as 80% of the

inhaled mercury may be absorbed into the blood stream, thus creating the following:

- Short-term exposures can cause poisoning, pneumonitis, bronchitis, and bronchiolitis.
- Repeated exposure to relatively low toxic levels can cause muscle tremor, irritability, personality changes, and gingivitis.
- Nerve damage from mercury may start as a simple loss of sensitivity in hands and feet, difficulty in walking, or slurred speech.
- Mercury has also been known to affect the development of prenatal life and infants." (Shaner, 1997)

When a mercury thermometer breaks, it is difficult and very expensive to clean up properly. If mercury spills from a thermometer and is not cleaned up, it will all eventually evaporate, potentially reaching dangerous levels in indoor air. A single broken fever thermometer containing 0.5 to 1.5 grams of mercury is enough to create a health risk when it evaporates into a small, poorly ventilated room ("How to Plan and Hold a Mercury Thermometer Exchange," Health Care Without Harm, 1999). Mercury clean-ups can be extremely expensive. If a carpet is affected, it must be removed, disposed of as hazardous waste, and a new carpet laid, creating clean-up costs in the thousands of dollars.

Given the highly accurate, non-mercury thermometer choices that are on the market, all health care institutions should be selecting non-mercury alternatives. Several hospitals have made great strides in mercury reduction, becoming virtually mercury-free in all of their medical equipment.

Saint Mary's Duluth Clinic

Saint Mary's Duluth Clinic in Minnesota is a small hospital that has made large reductions in its mercury use. The clinic instituted a mercury-free purchasing program in 1991 after participating in an educational seminar on the link between mercury use and pollution in Minnesota's lakes and streams. Saint Mary's stopped purchasing mercury thermometers and blood pressure units in the first year of their program and has since nearly eliminated mercury batteries, rubber cantor tubes, and mercury fixatives. In addition, the clinic has started an aggressive fluorescent light recycling program and has stopped sending mercury thermometers home with patients (this is now Minnesota law).

(Case Study from *Protecting by Degrees: What Hospitals Can Do To Reduce Mercury Pollution* by Environmental Working Group, 1999)

Actions

- Hold a mercury thermometer exchange
- Provide annual mercury training/spill/labeling program
- End the purchase of new mercury-containing equipment and implement a mercury-free purchasing policy for vendors that includes reagents and other background uses of mercury
- Create a replacement plan and budget for elimination of mercury-containing equipment
- Collect all wastes from processes involving the fixative B5 and designate a team to investigate the use of mercury-free alternatives
- Set up a fluorescent bulb (and other mercury containing bulb) recycling program
- Establish a battery collection program
- Develop a waste trap cleaning/replacement plan
- Implement a labeling and replacement plan for other mercury-containing devices (mechanical equipment).

(For more specific direction on accomplishing these objectives, see: *http://www.noharm.org/library/docs/SHEA_Proceedings_Mercury_Elimination_White_Pap.pdf.*)

In several cities around the country, nurses and others have organized mercury thermometer exchanges in their communities. In Washington, DC, the DC Hospital Association along with the local Health Care Without Harm Campaign and the City Health Department, supported by the city firehouses, did a city-wide mercury thermometer exchange whereby people brought their mercury thermometers to local firehouses and were given mercury-free thermometers. Health Care Without Harm has created a very helpful guide to implementing an exchange—see www.noharm.org to download the pamphlet "How to Plan and Hold a Mercury Thermometer Exchange." A community exchange program, in combination with elimination of all mercury-containing medical equipment, can make a significant impact on reducing mercury contamination in our rivers and lakes, which will translate to healthy people.

Don't send mercury thermometers home with new moms!

In a recent study, Carpi and Chen found that 10% of the homes they evaluated had indoor air levels of mercury exceeding the EPA's reference concentration (300ng/m^3) due to historic accidents with mercury-containing devices. Exposure to mercury via indoor air is seen as second only to fish consumption as a source of mercury in the general population (Carpi & Chen, 2001).

DEHP

The chemical compound DEHP, Di(2-ethylhexyl)phthalate, is contained in many of the common plastic products found in health care settings. It is in a category of toxic chemicals known as pthalates, which are commonly added to polyvinyl chloride (PVC) plastic to make the plastic product flexible and strong. It allows the otherwise stiff PVC to be molded into a variety of products such as IV tubing, IV bags, and feeding tubes. By weight, DEHP comprise 20-40% of the PVC products on average. There is new evidence regarding the human toxicity associated with exposure to DEHP that should help to inform our product selection in the health care setting.

FDA Safety Assessment of DEHP from PVC Medical Devices

"The FDA/CDRH has examined this [DEHP] issue and has concluded that children undergoing certain medical procedures may represent a population at increased risk for the effects of DEHP.

"This decision is supported by three findings:

1. Children undergoing some medical procedures receive a greater dose of DEHP, on a mg/kg basis, than adults do,
2. Pharmacokinetic differences between children and adults may result in greater absorption of DEHP, greater conversion of DEHP to MEHP (the toxic metabolite of DEHP), and reduced excretion of MEHP in children compared to adults, and
3. Children may be more pharmacodynamically sensitive to the adverse effects of DEHP than adults are."

FDA web site, see: *http://www.fda.gov/cdrh/ost/dehp-pvc.pdf.*

This conclusion is consistent with that reached by the expert panel convened by the Center for the Evaluation of Risks to Human Reproduction of the National Toxicology Program.

"DEHP does not bind with plastic, so it can leak out of PVC medical products during medical procedures, or when PVC objects such as toys are chewed. Everyone is exposed to DEHP through off-gassing from vinyl products in the home and workplace, as well as from industrial emissions. However, some infants and especially pre-term neonates are receiving, in some cases, megadoses of DEHP. Neonatal nurses should know what they can do to protect their tiny patients from the potentially harmful effect of DEHP. The multiple and relatively high exposures that may occur in neonatal intensive care units (NICUs) are significant. Many of these babies are exposed during blood and other intravenous infusions, respiratory therapy, enteral feedings and extra corporeal membrane oxygenation (ECMO)" (quote from Ann Melamed in *The American Nurse*, December 2000, online at *www.nursingworld.org/tan/novdec00/pollutio.htm*).

The National Toxicology Program's Expert Panel who reviewed DEHP studies only looked at reproductive and developmental effects. Based on animal studies, there are concerns that there may also be effects on the liver, kidneys, and lungs, as well as effects on heart rate and blood pressure. (See insert "Relevant Animal Studies" for review of animal study results.) Nonetheless, the Expert Panel noted the following:

DEHP Health Risks by Population

Critically Ill Infants:
"The available reproductive and developmental toxicity data and the limited but suggestive human exposure data indicate that exposures of intensively-treated infants/children can approach toxic doses in rodents, which causes the Panel serious concern that exposure may adversely affect male reproductive tract development" (page 101).

Healthy Infants and Toddlers:
"If healthy human infant/toddler exposures is several-fold higher than adults, the Panel has concern that exposure may adversely affect the male reproductive tract development" (page 101).

Pregnant and Lactating Women:
"(T)he Panel has concern that ambient oral DEHP exposures to pregnant or lactating women may adversely affect the development of their offspring" (page 102).

(Source Document: U.S. Department of Health and Human Services, 2000.)

So how does the chemical DEHP create a risk to humans when it is in PVC medical devices? When it is in PVC, it is not actually bound chemically. It can therefore escape the PVC product under certain conditions such as when the product is heated, or when the medical device contacts fluids—such as the fluids that would be in an IV or blood bag. DEHP migrates into a variety of fluids including blood, plasma, and total parenteral and enteral nutrition solutions. During medical interventions that require long-term IV interaction such as hemodialysis or ECMO, DEHP exposure is significantly enhanced. Pediatric exposures are of the greatest concern. Sick newborns and infants face the greatest risk of exposure from medical interventions and may also be the most vulnerable to the toxic effects of DEHP because of their stage in human development.

During critical stages of development, preterm babies, and neonates may be exposed to DEHP, a reproductive and developmental toxicant. This occurs because of the ubiquitous presence of DEHP in their environment. The multiple and relatively high exposures that can occur in the NICU are potentially at or in excess of levels known to cause adverse health effects in relevant animal studies.

"Since DEHP releases to vinyl products are not easily controlled, prevention should be the primary management option" (Rossi, 2000). To ensure that our patients are not exposed to DEHP, we will have to demand DEHP-free health care products, particularly in those settings where our smallest and most vulnerable patients are cared for. Using PVC-free products virtually assures that the product will be DEHP-free because the other plastics rarely add DEHP. "In addition, PVC-free products avoid the lifecycle hazards of vinyl, including the use of a known carcinogen to manufacture vinyl (vinyl chloride monomer) and the downstream formation of dioxin when vinyl is burned in a medical waste incinerator" (Rossi, 2000; Thornton et al., 1996; Wagner and Green, 1993).

PVC is the most widely used plastic in medical products. It accounted for 27% of all plastic used in durable and disposable medical products in the United States in 1996 (Schettler et al., 2000). Approximately 445 million pounds of PVC were consumed in the manufacture of intravenous (IV) and blood bags, tubing, examination gloves, medical trays, catheters, and testing and diagnostic equipment in 1996. Tubing, IV and blood bags, and gloves are the primary end-uses for PVC in disposable medical products. Both patients' health and safety, as well as the public's health, are of concern regarding PVC.

In January 2002, the Health Canada Expert Advisory Panel recommended that health care providers not use DEHP-containing devices in the treatment of pregnant women, breastfeeding mothers, infants, males before puberty, and patients undergoing cardiac bypass, hemodialysis, or heart transplant surgery. They recommended the alternative measures be introduced "as quickly as possible."

DEHP-Plasticized PVC Products in the NICU

Feeding-Related Products
Breast milk delivery tube
Enteral feeding bags
Lipid extension tubes
NG tubes
Tubing for breast pumps

Respiratory Therapy Products
ET tubes and trach tubes
Humidifier (sterile water bags, tubing)
Oxygen masks and tubing
Resuscitators, O2 reservoir bags
Suction tubing
Ventilator tubing

Intravenous Products
IV bags
IV tubing
Red blood cell bags

Sources of Dermal Exposure
Exam gloves
Patient ID bracelets

Other Potential PVC Products
Drainage tubes and bags
Isolette portal covers
Mattress covers
Flooring and wall covering
Ostomy and neuro shunt bags
Umbilical vessel catheters

[Sources: Sustainable Hospital Project, 2000, "Alternative Products," see: *http://www.uml.edu/centers/LCSP/hospitals/* (Lowell: Sustainable Hospitals Project, U.Mass., Lowell); and Tickner et al.., 1999, The Use of Di-2-Ethylhexyl Phthalate in PVC Medical Devices: Exposure Toxicity, and Alternatives (Lowell: Lowell Center for Sustainable Production, UMass Lowell.)]

Relevant Animal Studies Regarding DEHP Exposures and Toxic Effects

Animal Species	Target Organ	Effect
Rat	Testes	Disorganization of seminiferous tubule structure in male offspring, sertoli cell vacuolation, atrophy of seminiferous tubules, loss of spermatogenesis, testicular and epididymal atrophy, testicular agenesis, hemorrhagic testes, and hypospadias
Rat	Ovaries	Suppressed or delayed ovulation, suppressed estradiol production, polycystic ovaries
Human neonate	Lungs	Respiratory distress, pathological changes resembling hyaline membrane disease
Rat	Heart	Decreased heart rate and blood pressure
Rat	Kidneys	Reduction in creatinine clearance, cystic changes
Mouse	Fetus/embryo	Fetal death, exencephaly, open neural tubes, reduced pup size
Monkey	Liver	Abnormalities in histology, reduced liver function

Table adapted from Table 1.Toxicity of DEHP to Various Organ Systems, p. 3, in *Neonatal Exposure to DEHP and Opportunities for Prevention*, Mark Rossi, 2000. To download the entire report with full scientific references, see: *http://www.noharm.org/library/docs/Neonatal_Exposure_to_DEHP_di-2-ethylhexyl-phth.pdf*

Actions

Elimination of DEHP exposure can occur when DEHP-free products are selected.

The Sustainable Hospitals Program at the University of Massachusetts, Lowell, can be an invaluable resource to assist you in selecting alternatives. They have been researching and evaluating hospital products and have created a list of DEHP-free alternatives for a vast array of products. They provide the product type and the manufacturer information, including phone num-

bers and Web sites. See its Web site: *www.sustainablehospitals.org* for product information regarding DEHP (as well as mercury-free choices, latex alternatives, safer needle devices, and other extremely useful information).

Dioxins

Dioxins are a family of highly toxic chemicals that are in our environment—in our air, water, soil, and food supply, as well as in our bodies. Dioxins are not intentionally produced, but rather are by-products of combustion and industrial processes, including the manufacture of chlorinated chemicals, the bleaching of paper products, and the incineration of waste (municipal, hazardous, and *hospital waste*). Dioxins are one of a grouping of toxic pollutants that are persistent in our environment, as well as in the human body. Once they get into the environment and into our bodies, they do not quickly biodegrade into something less toxic, and they have extremely slow natural paths for removal or excretion. They are believed to have a half-life of seven to twelve years in the human body (Wolfe et al., 1995).

Dioxin bioaccumulates in such a manner that it biomagnifies up the food chain. Contamination in the food chain begins with dioxin particles in water or soil and then proceeds up the food chain through fish and livestock, ultimately reaching human tissues through the food we eat. It becomes increasingly concentrated in living tissues as it moves up the food chain (Oris, 2000).

Approximately 90% of human exposure to dioxin comes from food, specifically in the form of beef, fish, and dairy products. According to the EPA, beef and dairy products remain among the leading sources of dioxin exposure to adults. In 1998, *Consumer Reports* assayed the dioxin content in a dozen brands of baby food jars of meat. They projected that "a baby who ate one jar—just 2.5 ounces—of an average meat-based baby food on a given day would consume around 100 times the EPA's daily limit of dioxins. No brand was significantly more contaminated than another" (*Consumer Reports*, 1998). When dioxin is consumed by humans, it is stored in the fatty tissue—it is lipophilic. Human babies who are breastfed can receive 10% of their lifetime exposure to dioxin from their mother's fat-laden milk. As nurses, we should continue to advocate that women breast feed, as we concurrently advocate for policies and practices that will decrease the dioxin levels in our environment.

Studies of humans occupationally exposed have shown dioxins to be associated with cancer of the lung, thyroid gland, hematopoietic system, and liver, as well as connective and soft tissue sarcoma (Thornton et al., 1996). According to the EPA draft report on dioxin's health effects, the levels of dioxin-like compounds found in the general population may cause a lifetime cancer risk as high as one in 1,000. This is 1,000 times higher than the generally "acceptable" risk of one in a million. For the most recent EPA statements on dioxin, see the draft reassessment report, *http:/cfpub.epa.gov/ncea/cfm/dioxreass.cfm?ActType=default*.

In addition to dioxin's carcinogenicity status, it is also a known endocrine disruptor, a chemical that mimics or otherwise disrupts normal hormone activity. Endocrine disruption can occur at extremely small doses of exposure. Theo Colborn, in her 1996 book *Our Stolen Future*, describes the amassing research on endocrine-disrupting chemicals in our air and water and their effects in nature and on human health. While early discussions of endocrine-disrupting chemicals focused on estrogenic effect of environmental contaminants, more recent research extends concerns to anti-estrogens, androgens, or anti-androgens, as well as thyroid hormone, cortisone, and others (McLachlan, 1985). Animal studies confirm a wide range of reproductive and developmental effects of dioxin in different species, some occurring at very low exposure levels. They include changes in hormone levels, fertility, sexual behavior, litter size, ability to carry pregnancy to term, birth defects, learning disabilities, and endometriosis. A potential connection existing between exposure to dioxin and endometriosis is based on primate studies wherein dioxin exposure increased the incidence and severity of endometrosis in monkeys and in rodent populations (Birnbaum and Cummings, 2002).

"Human studies designed to examine reproductive or developmental effect of dioxin exposure have produced mixed results. The studies are often limited by inadequate exposure information, incomplete recognition of health outcomes, or low power to detect rare events, and they virtually always lack an unexposed control population. Nevertheless, there is now sufficient evidence to conclude that dioxin is probably a cause of some birth defects. There is also evidence that testosterone levels are depressed in occupationally-exposed workers, and thyroid hormone is depressed in infants exposed at ambient levels through breast feeding." (Schettler et al, 2000)

The EPA has been in a multidecade-long process to assess (and reassess) the health risks of dioxin. The discussions and debates are often as influenced by economics and politics as they are by science. Dioxin is one of the 12 chemicals covered by the United Nation's Stockholm Convention on Persistent Organic Pollutants (POPs), which the United States signed in May, 2001. This Convention calls for the reduction of industrial dioxin releases, including those from medical waste incinerators.

Human Cancer Classification of Dioxin by Agency

Environmental Protection Agency	Dioxin (2378-TCDD and related compounds) are known carcinogens
National Toxicology Program of the NIH (http://ntp-server.niehs.nih.gov/)	Dioxin (2378-TCDD) is a known carcinogen
International Agency for Research on Cancer (IARC)	Dioxin is a known carcinogen
National Institute of Occupational Safety and Health	Dioxin is a probable carcinogen

Actions

In the health care industry, dioxin is primarily a product of waste incineration. Therefore, the prime action is to discontinue the incineration of hospital waste and choose non-incineration alternatives.

During the manufacture of (PVC) plastics, dioxins are created, as they are when incinerated. Therefore limiting the use of plastics is recommended:

- Eliminate plastic utensils and replace them with stainless steel.
- Eliminate plastic covered "chux" and replace them with washable, cotton pads.
- Request that products have only essential packaging, thereby reducing redundant plastic packaging.

The Hospitals for a Healthy Environment, Health Care Without Harm, and Sustainable Hospital's Web sites all have excellent guidance for reducing PVC use in hospitals, with valuable information on the alternatives. They also provide comprehensive guidance on waste reduction. See: *http://www.h2e-online.org/, www.noharm.org, and www.sustainablehospitals.org*, respectively.

Incineration

Incineration, the process of burning waste, is an age-old practice for waste management. However, the process of burning modern-day waste, particularly medical waste, presents us with new and extensive environmental health risks because of the makeup of the waste stream. Incineration creates toxic air pollution and toxic ash. The air pollutants can affect both the local communities and can travel the jet stream to pollute distant lands and people. The ash may be placed in a landfill, creating the potential for the pollutants to leach into our ground water. Some of the pollutants persist in the environment, accumulating in the environment and in our bodies. The incineration of regulated medical and general hospital waste results in air and water emissions of dioxin, mercury, other toxic metals, particulates, and sulfur dioxide (Johnston and Erickson, 2000).

During the combustion process of incineration, new chemical compounds can be created. It is during this process that dangerous dioxins are unintentionally created. Dioxins, which are chlorine compounds, are created during combustion in the presence of chlorinated waste such as bleached white paper and polyvinyl chloride plastic. The EPA has identified medical waste incineration as the third largest source of dioxin air emissions and as the contributor of about 10% of the mercury from human activity (US EPA, 1997).

Plastics comprise roughly 15—30% of the medical waste stream, roughly twice as much as is found in municipal waste streams. Polyvinyl chloride plastic (PVC) is approximately 50% chlorine by weight. Paper and cardboard comprise 45—50%, food waste 10%, glass 7%, wood 3%, metals 10%, and other materials approximately 10% (Shaner, 1993).

In addition to dioxins and mercury, many other hazardous pollutants have been identified in medical waste incineration emissions, including:

Arsenic	Ammonia	Benzene
Bromodichloromethane	Cadmium	Carbon tetrachloride
Chromium	Chlorodibromomethane	Chloroform
Cumene	1,2-dibromethane	Dichloromethane
Dichloroethane	Ethyl benzene	Lead
Mesitylene	Nickel	Particulate matter
Naphthalene	Tetrachloroethane	Toluene
Trichloroethane	Vinyl chloride	Xylene

Actions

Careful waste segregation provides an opportunity to select the most environmentally safe disposal for each category of waste. Nurses can play a pivotal role in the process of identifying opportunities for improving waste segregation, including decisions about products for reuse, recycling, and the safest methods of disposal.

Stephanie Davis (ScD18@WasteReductionRemedies.com), a waste management specialist, has created a ten-item set of guidelines for systematically reducing regulated medical waste; available in Going Green: A Resource Kit for Pollution Prevention in Health Care: www.noharm.org.

There are a variety of alternatives to incineration for the treatment of waste. Although each of them has its own pros and cons, none creates the same level of environmentally unhealthy consequences as incineration. The alternatives include autoclave/steam sterilization, microwave, and chemical disinfection. When any of these methods are chosen, the treated waste is then placed in a landfill. An extensive and technical discussion on alternatives to incineration can be found in the report, "Non-Incineration Medical Waste Treatment Technologies: A Resource for Hospital Administrators, Facilities Managers, Health Care Professionals, Environmental Advocates, and Community Members" (2001) found on the Web site: *http://www.noharm.org/library/docs/Non-Incineration_Medical_Waste_Treatment_Techn.pdf*

Hazardous Products and Processes in Health Care

It is possible to eliminate or significantly reduce hazardous exposures to workers in the health care setting (or any other work setting) by employing the Industrial Hygiene Hierarchy of Controls. This hierarchy provides a framework for categorizing methods of health and safety measures. They are listed in the order of their effectiveness:

1. **Elimination** of hazardous materials and dangerous activities (needleless IV systems, no lifting)
2. **Substitution** of less hazardous materials (substitute oxidizing chemicals such as paracetic acid for glutaraldehyde, nitrile gloves for latex or vinyl gloves)
3. **Engineering Controls**, the use of technical means to isolate or remove hazards (safer needle devices, lifting devices)
4. **Administrative Controls**, policies that limit worker exposures to hazards (appropriate allocation of resources to prioritize health and safety, rotation of staff to minimize exposure time in areas where they may be exposed)
5. **Personal Protective Equipment** (PPE), barriers and filters between the worker and exposure (gloves, respirators, gowns, etc.)

Another important tenet in worker protection is appropriate employee training and education about potential hazards and safe work practices. When workers have a good understanding of why they should employ certain safety precautions or processes, they are more likely to comply.

For more information on the Industrial Hygiene Hierarchy of Controls and occupational safety and health, see the federal Occupational Safety and Health Administration Web site: *www.osha.gov*.

Cleaning and Disinfectant Products

Health care institutions pride themselves in the exceptional attention they pay to cleanliness. However, many industrial strength cleaners and disinfectants present health risks to employees and patients during application and afterwards. They may contribute to poor indoor air quality, trigger asthma events, cause skin and mucous membrane irritation, and even cause neurological effects. The most frequently reported hazardous exposures in health care were latex, poor indoor air quality, and toxic cleaning products (MA DPH SENSOR, 2000). (For more information on latex exposure, see: *www.nursingworld.org* or *www.niosh.gov*.) By carefully choosing environmentally healthier and safer cleaning chemicals, cleaning methods, and cleaning equipment, health risks can be reduced. More than 70,000 chemicals are registered with the EPA for use in cleaning products, including a number that are suspected hormone disruptors and carcinogens (Green Birthdays, 2001).

Disinfectants and Sterilants

Disinfectants and sterilants used in hospitals, such as quaternary ammonium compounds, phenols, bleach, and ethylene oxide are registered with the EPA as pesticides. These toxic chemicals are used for routine cleaning on every surface in the hospital environment, as well as for sterilizing equipment. Ethylene oxide, a cold sterilizing agent, is a carcinogen and a reproductive toxin that can cause miscarriage (Danielson, 1998). There is currently an Occupational Safety and Health Standard for ethylene oxide because of its health risks. There is a web-based fact sheet on ethylene oxide that describes six alternatives to ethylene oxide sterilization, including steam and ozonation processes. For more detailed information, see: *http://es.epa.gov/techinfo/facts/ca-htm/oxide-fs.html*.

Glutaraldehyde is a potent skin irritant and sensitizer known to trigger asthma (Nethercott, 1988; Di Stefano et al., 1999). Effective and less hazardous alternatives to glutaraldehyde are available. The Sustainable Hospitals Program lists a number of acceptable alternatives on its Web site: *www.sustainablehospitals.org*. The Occupational Safety and Health Administration is currently developing an occupational exposure standard for glutaraldehyde because of the health risks that it can pose. (Some brand names for glutaraldehyde are: Cidex, Aldesen, Hospex, and Sonacide.)

Floor Care Products

Many floor care products used in hospitals, including wax strippers, contain known hazardous substances. Chemicals included in these products include diethylene glycol ethyl ether, aliphatic petroleum distillates and nonyl-phenol ethoxylate, ethanolamine (a known sensitizer), butoxyethannol, and sodium hydroxide (lye). (HCWH, 2001) Available at: *www.noharm.org*. See *Going Green*). A number of health effects are associated with this constellation of floor chemicals including: respiratory, eye and skin irritation; nausea; headache; difficulty in concentrating; and asthma events. Industrial strength cleaners often require diluting before use and janitorial staff, whose first language may not be English or who have literacy problems, may have difficulty in following written directions for diluting. Problems with acute exposures to cleaning problems can occur if full strength solutions are used. Pour-and-wipe applications decrease the types of airborne exposures that may occur when spray bottles, aerosol cans, or mechanical devices are used for dissemination of the product. Adequate ventilation, well-trained cleaning staff who understand the correct diluting ratios and methods, and choosing the least toxic chemicals can significantly reduce the risks of health effects and injuries.

Resources for Cleaning Products

- Report on cleaning chemicals and solutions—email: Sutherland@inorminc.org
- List of environmentally-preferable cleaning products—mail: MA Operational Services Division, One Ashburton Place, Rm. 1017, Boston, MA 02108
- Quick reference and worksheets from the Janitorial Pollution Prevention Project—Web site: *www.westp2net.org/Janitorial /jp4.html*
- The American Society for Testing Materials has a standard for the selection of environmentally-preferable cleaning agents and processes: "Guide D6361-98 Standard Guide for Selecting Cleaning Agents and Processes," see *www.astm.org*

There are several municipal initiatives to reduce the use of toxic cleaning products by public workers, including the Sustainable City Program of Santa Monica, California. In an effort to purchase less harmful products, the program evaluated cleaners for their environ-

mental and health effects. As a result, they reduced the use of hazardous products, saved money, and reduced worker complaints. In general, less toxic alternatives should not contain: ammonia, chlorine, phosphates, alkylphenol ethoxylates, volatile organic compounds (VOCs), propellants, or petroleum solvents. Additional considerations should be to avoid caustic or corrosive products (very low or high pH), unnecessary fragrances (which may affect people with asthma or chemical sensitivity), and unnecessary packaging (which will merely contribute to the waste stream).

Pesticides

Pesticides are chemicals that are formulated to kill or prevent reproduction in a variety of pests such as insects, rodents, weeds, and microbes. All pesticides are required to be registered by the EPA. In New York State, in 1995, the Attorney General surveyed hospitals in the state and found all but three of them used pesticides. The science regarding health effects and pesticide exposures is creating mounting evidence that we must proceed with much caution when trying to control pests.

Human Health Effects Associated With Pesticides

Acute Effects
- Irritation of eyes, nose, throat and skin
- Nausea, vomiting, and diarrhea
- Coughing, wheezing, and asthma events
- Headaches, dizziness, and loss of consciousness

Chronic Effects
- Cancer
- Reproductive and developmental dysfunction
- Endocrine disruption
- Immunological and neurological dysfunction
- Respiratory disease
- Behavioral impairment
- Skin conditions

(Physicians for Social Responsibility, 2000)

Integrated Pest Management (IPM) is a philosophy and system of managing pests that provides a framework for removing life support systems for pests (food, water, and nesting space) along with least hazardous methods such as traps and sticky tapes before moving on to chemical solutions. If chemical solutions are required, then the selection of the least toxic choices come first. This staged system of pest control can significantly reduce an institution's reliance on hazardous pesticide applications, thus removing the associated health risks to the workers in the institution, the patients and their families, and the environment generally. There are a number of excellent IPM resources. See: *http://www.epa.gov/pesticides/ipm/#fact*, *www.oag.state.ny.us/environment/environment.htm*, *www.crisny.org/not-for-profit/nycap/nycap.htm*, and *www.behondpesticides.org*.

The 10 teaching and research hospitals associated with Harvard University have been practicing Integrated Pest Management for about 15 years. They use sticky traps, vacuums, caulking, silica gel, and other typical IPM methods. As necessary, they use boric acid and pyrethrum formulations that are generally applied as crack and crevice treatments. They use no rodenticides, no pesticide sprays, mists, or fogs, and no "preventative" pesticide applications (New York City Health Care Without Harm Coalition, 2000).

Integrated Pest Management Actions

- **Careful Monitoring**—Clearly define the type of pest, the level of infestation, the area infested, and the pathways of entry and dispersal. Well-placed and carefully observed sticky traps can also help locate pests' points of entry and hiding places.
- **Sanitation and Maintenance**—Remove the sources of food and water; without these sources, pests will die or simply go elsewhere. Good housekeeping and timely repairs work wonders.
- **Physical barriers**—Screen, caulking, door sweeps, and similar devices can eliminate pest access to the hospital interior, to specific areas within the hospital, or to waste containers outside.
- **Mechanical controls**—Traps can catch and kill rodents. Flying insects can be controlled with properly placed "bug zappers."
- **Insect sex attractants or hormones** used in baits and traps can interfere with breeding, arrest development, or simply enhance the effectiveness of a trap.

(New York State Health Care Without Harm Coalition, 2000)

Environmentally-Preferable Purchasing

Through the careful selection and purchase of less toxic products, our work as health care providers becomes more internally consistent. We can indicate an additional level of caring for our employees, patients, and community members by taking the time to understand the products that we choose to have in the health care setting. By understanding how the products are made, including the occupational and environmental health risks posed by their production processes, as well as the impacts of their final disposal, we begin to understand the full "life cycle" of the products we select and all of their potential impacts. 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 (Health Care Without Harm, available online: *www.noharm.org*). Environmentally preferable purchasing can be implemented in clinics and school health suites as well as hospitals.

Obviously, implementing an EPP program in a hospital is a complex endeavor. A team approach will facilitate change. Many hospitals are members of Group Purchasing Organizations—organizations established to make bulk purchases for several hospitals or hospital systems. The GPOs interface directly with vendors to purchase many hospital products. Therefore, an EPP team should include all those who help to make purchasing decisions, including the GPOs. Nurses should be represented on this team and, if one does not exist, nurses can take leadership in helping to create a team. Goals should be established for the institution such as the phase-out of mercury-containing products or reducing the packaging waste by purchasing products with less "packaging." A "How-to Guide" for Environmentally Preferable Purchasing can be found at the Health Care Without Harm Web site, *www.noharm.org* under the "Going Green: A Resource Kit for Pollution Prevention in Health Care."

The Sustainable Hospital Project—*www.Sustainablehospitals.org*

The Sustainable Hospital Project at the University of Massachusetts—Lowell has a web-based clearinghouse for selecting products and work practices that eliminate or reduce occupational and environmental hazards, maintain quality patient care, and contain costs. Information about latex-free medical gloves, safer needle devices, alternatives to PVC products, batteries, and mercury-free products can be found at its site.

Almost half of U.S. hospital waste is office paper and cardboard, and most of the paper products have been bleached with chlorine during the paper production process. By moving to the purchase of chlorine-free paper, a number of healthier and safer impacts will be experienced. During the production of bleached paper, a number of pollutants are released into the environment, including dioxin. An average paper mill that uses chlorine will use around 35,000—45,000 gallons of water per ton of pulp, whereas a chlorine-free pulp mill will use 2,500—3,000 gallons per ton of pulp. The non-chlorine process results in the use of less water and energy and produces less pollution. Nurses should be advocating that chlorine-free paper be used in all of their workplaces. For more information on chlorine-free paper product selection, see Web site: *www.chlorinefreeproducts.org*.

Because so much of hospital waste is paper products, it is essential to recycle the paper after use. Hospitals can realize a huge reduction in their waste stream and waste-related costs by recycling paper.

Actions

Follow the Ten Actions to Promote Environmentally Preferable Purchasing (EPP).

Ten Actions to Promote Environmentally Preferable Purchasing (EPP)

What is Environmentally Preferable Purchasing? EPP is the act of purchasing products and services whose environmen-

tal impacts have been considered and found to be less damaging to the environment and human health when compared to competing products and services. EPP is a culture that must be fostered at all levels, including development of government and health care industry policies. However, there are many everyday actions that can promote and reinforce EPP. Here are ten:

1. Print a copy of the Hospitals for a Healthy Environment (H2E) "EPP How To Guide," read it, and pass it on or post it. Make it required reading for people in your department. This guide was written by the EPP Work Group of Hospitals for a Healthy Environment and is available online at: *www.geocities.com/EPP_How_To_Guide*

2. Understand why the purchasing stage is important.
   - Procurement of most products and services goes through the Purchasing Department.
   - Money changes hands here, offering the greatest leverage on vendors.
   - The closer to the source a problem is corrected, the less costly it is (dollars, adverse publicity, technical complexity.)

3. Incorporate environmental language in your requests for proposals (RFPs) and purchasing contracts.

4. Continually ask your vendors and Group Purchasing Organizations for products that are environmentally preferable.

5. Implement modest, measurable goals for EPP, then monitor progress. For example, buy only non-mercury thermometers, sphygmomanometers, and esophageal dilators.

6. Visit the Sustainable Hospitals Web site, *www.uml.edu/centers/LCSP/hospitals*, for a list of alternative health care products and practices. Contact the SHP Clearinghouse for additional information and printed resources: phone: 978-934-3386 and e-mail: shp@uml.edu

7. Subscribe to an EPP Newsletter. Ask for an electronic copy, rather than paper. A terrific EPP newsletter is published by the Massachusetts Office of Technical Assistance. Read it online at *www.state.ma.us/ota/otapubs.htm#eppnet*

8. Build a network of resources that provide good ideas and allow you to identify best practices. Visit the Web site: *www.ciwmb.ca.gov/BizWaste/Factsheets/Hospital.htm for starters.*

9. Ask hospital personnel how everyday activities can be tuned to be more environmentally sound. Work with vendors to incorporate employees' suggestions. With a little prompting, an abundance of good ideas will come forth. For example, when evaluating copy machines, place a premium on ones that are strong on two-sided copying.

10. Broadcast your successes. For example, use the hospital newsletter to promote EPP achievements.
("Environmentally Preferable Purchasing How To Guide," Hospitals for a Healthy Environment (an AHA/EPA Partnership), online at *www.h2e-online.org*)

Batteries

Batteries come in all sizes and shapes and are produced for many uses. Additionally, they often contain toxic chemicals that should never be incinerated. In hospitals, batteries power pagers, IV pumps, fetal monitors, flashlights, and a variety of diagnostic scopes. Some batteries contain mercury, some lead, some cadmium, and some lithium. Whenever possible, rechargeable batteries should be employed. When this is not possible, a careful battery round-up should be implemented to capture and recycle or appropriately dispose of the batteries. For more guidance, see "Battery Round-ups—Get Charged!" on the Health Care Without Harm web site: *www.noharm.org* in the Going Green: A Resource Kit for Pollution Prevention in Health Care.

Actions

Use rechargeable batteries whenever possible. On the Sustainable Hospital Program's Web site a list of rechargeable batteries is presented. See: *www.sustainablehospitals.org*.

If rechargeable batteries are not possible, collect and recycle used batteries. Make it easy for those who use batteries to do this. For example, place the recycling container where the new batteries are stored so that recycling can be accomplished concurrently with replacement.

Pollution Prevention

There are several important tenets to pollution prevention:
- Use the ***least amount*** of "stuff" to begin with;
- Select the ***least toxic*** product and processes;
- Choose products that can be ***reused*** versus disposable;
- ***Recycle*** products when reuse is not possible;
- Carefully ***segregate waste*** to optimize your reuse, recycling, and disposal choices;
- Opt for the most ***environmentally sound disposal*** practices; and
- ***Avoid incineration***.

Waste Minimization in Health Care Settings

Managing health care related waste in an environmentally sound way can also be a cost-saving management strategy. When Beth Israel Medical Centers, in New York, implemented an aggressive waste minimization strategy in 1996, to reduce both the volume and toxicity of their waste, their resulting program saved the hospital $600,000, a savings that has subsequently been realized annually. Here are the steps outlined by the Health Care Without Harm Campaign for waste minimization, segregation, and recycling in hospitals in their Going Green resource kit:
- Establish a **"Green Team"** made up of nurses, administrators, housekeeping staff, and others who are responsible for waste handling and occupational and environmental health and safety.
- Conduct a **"waste audit"** by examining what comes into the hospital and what (and how it) leaves. Observe red bag waste, solid waste, food waste, laboratory chemicals, and chemotherapeutic and pathological waste. (Typically, about 85% of the waste will be noninfectious and similar to the waste one would find in a hotel or even an office building. The remaining 15% is classified as "regulated" or "potentially infectious" and must be handled in a special manner.)
- Use the results of the audit to identify wasteful practices and develop a **waste management strategy** that incorporates waste **reduction, reuse, and recycling measures. Segregating the waste** at the point of generation, before treatment or disposal, is critical.
- **Educate** all hospital staff about the safe and appropriate segregation of waste for recycling, reuse, and disposal. Cardboard, glass, office paper, cans, newspapers, magazines, and certain plastics are commonly recycled. (See inset for listing of recyclables.) Place signage at the point of waste disposal (trash cans, garbage bins, recycling containers, battery capturing receptacles) to reinforce the directions for proper segregation and disposal.
- **Combine waste management strategies with sound purchasing practices** to select reusable versus disposable products, as well as less hazardous products and products with less packaging.

The Nightingale Institute for Health and the Environment (*www.nihe.org*) lists several additional recommendations for managing medical waste: (1) Stay focused on reduction; (2) Ensure worker health and safety—provide appropriate personal protective equipment, as necessary; (3) Utilize safe medical waste treatment and disposal technologies; and (4) Ensure safe handling, storage, and disposal of hazardous materials, in accordance with environmental regulations (Shaner and McCray, [online] available: *www.nihe.org/elevreng.html*).

"Environmentally smart materials management prevents problems down the road, such as mercury spills, grown waste disposal costs, dioxin creation, public relations problems from health care's environmental impact, etc. The three **R**'s of environmental responsibility—**reduce, reuse, recycle**—all involve opportunities to prevent waste and eliminate toxic materials through materials management choices. When a hospital opts for disposable products in place of reusable ones, it increases the volume of waste dumped in landfills. When a hospital chooses mercury thermometers instead of digital, it increases mercury pollution at landfills and incinerators. Conversely, when Materials Managers evaluate the entire life of the product they are considering buying, they can reduce the negative environmental impact of the products.

"When hospitals choose to buy aneroid sphygmomanometers instead of mercury blood pressure gauges, they protect hospital staff, patients,

the community and the environment. These environmentally-friendly decisions are also frequently cost-effective, as well. The cost of an aneroid blood pressure gauge can be less expensive than a sphygmomanometer containing mercury. Materials managers can take actions that reduce waste volume and toxicity throughout the facility. Their efforts are often easier to manage and can have a greater impact than end-of-the-pipe waste management" (New York City Health Care Without Harm Coalition, 2000).

Recyclables in Health Care Settings

Batteries:
- Ni-Cad
- Lead Acid
- Alkaline
- Mercury oxide
- Lithium
- Zinc air
- Dry cell
- Others

White office paper
Mixed office paper
Corrugated cardboard
Boxboard
Junk Mail
Newspaper
Magazines
Books
Steel cans
Silver
Aluminum
Toner cartridges
Glass
Xylene
Fluorescent lights
Formalin
Overhead transparency film

Plastics #1 PETE, #2 HDPE, #3 PVC, #4 LPDE, #5 PP, #6 PS, #7 mixed

Use *Reusable* Alternatives to these Disposable Products

Bedpans and urinals
Resuscitation bags
Thermal blankets
Suture removal sets
Washcloths
Cover gowns
Diapers
OR gowns and packs
Underpads
Laser printer cartridges

Reuse Success Stories

- At Boston's New England Medical Center, sharps containers are sent to a company in New York to be sterilized and then shipped back for reuse.
- New York's Beth Israel Medical Center has switched from disposable to reusable food service plates, silverware, trays, examination gowns, and bed underpads. (Contact person at EPA for more detailed information on such pollution prevention strategies: Russ Clark (202) 564-8856.)
- One hospital saved over $100,000 a year by returning to reusable scrubs in the OR.
- Mattresses are now available with built-in egg crate foam pads rather than having to provide disposable ones for each patient.

(Maryland Public Interest Group, 2000)

Nursing Leadership and Advocacy

We are living in a time of incredible possibilities. We are also living in a time of troubling contradictions. So many of our essential practices—energy production, food production, transportation, and even the provision of health services—are not sustainable, not compatible with a healthy environment and thereby healthy people. Nurses, as the foot soldiers and generals in the defense of our public's health, have the potential to lead our patients and communities. We can educate and guide our policy-makers, including elected officials, to a new way of seeing the relation between our life's choices (both individual and societal) and their impact on health. Nurses are trusted and credible sources of information and education regarding environmental health issues.

The good news is that there are a great many people in a wide range of organizations working on environmental health concerns related to the health care sector: from nursing professional associations, other nonprofit organizations, the federal government and academic institutions, to broad-based coalitions.

The ANA continues to advocate for and teach about environmentally safer and healthier hospitals in their joint venture with the EPA and the American Hospital Association (AHA) in the formation of the "Hospitals for a Healthy Environment" (H2E). H2E was born out of a landmark agreement between the EPA and AHA in 1998 to eliminate mercury from the health care waste stream and reduce total volume of waste by one third by 2005 and by half by 2010. An additional goal is to minimize the production of persistent, bioaccumulative, and toxic pollutants.

Many other organizations, including nursing subspecialty organizations, are taking active roles in encouraging expansion of nurses' roles in environmental health. The ANA has passed several environmental health-related resolutions, including a call for nurses to actively engage in pollution prevention. The American College of Nurse Midwives has assisted in the creation of a booklet entitled "Green Birthdays," in which they describe the environmental health risks to pregnant women and newborns in hospitals and birthing facilities. It also guides midwives in the creation of environmentally healthier birthing places. In this way, nurses can provide the necessary leadership to encourage *primary prevention* of environmentally-related illnesses, which is a prescription for primary prevention.

In 1994, the American Public Health Association (APHA) called for a timed phase-out of the production and use of materials that lead to the creation and release of persistent toxic substances, including chlorinated organic chemicals—a source of building blocks for dioxin. In 1996, APHA further recognized the relationship between medical waste incineration and dioxin formation and called for steps to minimize diox-

H2E Overview

The primary goal of the H2E effort is to educate health care professionals about pollution prevention opportunities in hospitals and healthcare systems. Through activities, such as the development of best practices, model plans for total waste management, resource directories, and case studies, the project hopes to provide hospitals and healthcare systems with enhanced tools for minimizing the volumes of waste generated and the use of persistent, bioaccumulative, and toxic chemicals. Such reductions are beneficial to the environment and health of our communities. Furthermore, improved waste management practices will reduce the waste disposal costs incurred by the health care industry.

To achieve the program's goals, the American Hospital Association and the US Environmental Protection Agency signed a landmark agreement to advance pollution prevention efforts in our nation's hospitals. The Memorandum of Understanding (MOU), which is the cornerstone of the H2E initiative, calls for:

- Virtually eliminating mercury-containing waste from hospitals' waste streams by 2005
- Reducing the overall volume of waste (both regulated and non-regulated waste) by 33 percent by 2005 and by 50 percent by 2010
- Identifying hazardous substances for pollution prevention and waste reduction opportunities, including hazardous chemicals and persistent, bioaccumulative, and toxic pollutants

AHA and EPA entered into the MOU to equip AHA members and other health care professionals with the tools and information necessary to achieve the goals outlined above. Such reductions are not only beneficial to the environment, but will also help hospitals minimize waste disposal costs, and realize cost savings.

Program Sponsors

H2E is a joint project of the AHA, the US EPA, Health Care Without Harm, and the ANA. In addition, various state and local resources have also joined the effort to help hospitals achieve the goals outlined in H2E.

How Can I Participate in H2E?

If your organization is a health care facility, you can join the H2E effort through the H2E Partners for Change program — *www.h2e-online/program/partners.htm*. Tools to guide pollution prevention activities include:

- Model plans for reduction of solid, infectious, and chemical waste—the goals of H2E
- Model plan for mercury elimination
- Model practice tool for minimizing the volumes of waste generated and the production of persistent, bioaccumulative, and toxic pollutants
- Resource directories
- Case studies

If your organization is not a health care facility, but you would like to help, consider joining the H2E Champion Program, *www.h2e-online.org/programs/champions.htm*. Champions encourage their members and customers to join the H2E program and attain the goals outlined above. It's a great way to help your members/customers reduce costs, while becoming better environmental stewards. H2E will also recognize top champions through its award program.

Where Can I Get Help?

A set of resources have been collected exclusively for the H2E program. See: *www.h2e-online.org/tools/index*

Last Updated: December 18, 2001
URL: *http://www.h2e-online.org/about/overview.htm*

in generation and release. Members recognized the need for a fundamental re-examination of materials and purchasing policies with the intent of reducing the use of hazardous products and keeping them out of the waste stream as much as possible without compromising patient care.

In 1997, the American Nurses Association House of Delegates passed a resolution for the "Reduction of Health Care Production of Toxic Pollution." In summary, the resolution called for the ANA to:

- Support the definition of regulated medical waste as developed by the Association of Operating Room Nurses (in their definition, "regulated medical waste" includes pathological waste, human blood, blood products, and body fluids plus four additional categories of waste—sharps, cultures and stocks of infectious wastes, animal waste, and selected isolation waste);
- Promote alternatives to products made from PVC; to support mercury-free health care delivery and facilities;
- Support non-incineration methods of medical waste disposal;
- Lobby for medical waste incinerator dioxin emissions to be less than 0.1 nanogram TEQ/dscm; and
- Educate nurses and other health care personnel about these issues.

Background documents for the resolution, a copy of the resolution, and many exceptional resources for nurses are provided in the ANA Pollution Prevention Kit that can be obtained through the ANA. (Available online: *www.nursingworld.org/DLWA/OSH*.) The kit includes two videos, one on mercury and one on PVC. It is important to note that the ANA resolution was passed before the nursing community was made aware of the issues involving DEHP; therefore there is no language regarding this new and emerging issue.

In recent years, Physicians for Social Responsibility, an international Nobel Peace Prize winning organization, has expanded its work to encompass environmental health. (See: *www.psr.org*.) Its national office in Washington, DC, monitors activities on Capitol Hill that relate to environmental health and provides training and education programs on such issues as drinking water quality and antibiotic use in agriculture. Their web site provides several important full-text works such as *In Harm's Way*, a book on children's health effects associated with persistent pollutants in our environment, including mercury and dioxin. They have an excellent new web site feature that allows the interested viewer to follow Congressional and regulatory efforts on environmental health. See: *www.envirohealthaction.org*.

Another set of potential partners for nurses interested in environmental health is the community of academics, government employees, and activists who are working on "sustainability," the art and science of living in a manner that is both friendly to the environment and healthy for all. Some of the campaigns that have evolved in the sustainability movement include: Smart Growth, "Reduce, Re-use, and Recycle" activities, and Green Buildings. Alliances with the sustainability community will help to build another practical and multidisciplined approach to creating an environmentally sustainable future. They share much common ground with the nursing profession.

Health Care Without Harm is the prime advocacy "organization" working with and in the health care industry to become environmentally healthy. Health Care Without Harm expanded internationally and now boasts hundreds of member organizations, with the ANA as one of their first and most important ones. Many nursing subspecialty organizations such as the Association of Operating Room Nurses and the American College of Nurse Midwives are also members. Health Care Without Harm is a democratically run campaign that has the following mission:

To transform the health care industry so it is no longer a source of environmental harm by eliminating pollution in health care practices without compromising safety or care.

All nurses are welcome to join the "Nursing Group" of Health Care Without Harm. On a monthly conference call, the group discusses nurses' roles in promoting and implementing the mission of the Health Care Without Harm Campaign. Susan Wilburn, senior occupational health and safety specialist at the ANA and Dr. Barbara Sattler, Director of the Environmental Health Education Center at the University of Maryland School of Nursing, co-coordinate the Nurses Work Group. The Health Care Without Harm web site provides invaluable information about the campaign, as well as contact information for getting involved—see *www.noharm.org*.

Summary

In summary, the last page of "Green Birthdays," the Health Care Without Harm and American College of Nurse Midwives publication for environmentally healthy and safe birthing places, provides an excellent synopsis of the actions promoted in this independent study module. It recommends:

- Reusable cutlery and dishware
- Reusable linens and diapers
- Reusable, mercury-free batteries
- Supplies with minimum packaging in reusable tubs
- Recycling bins for paper, plastic, and cans
- A red bag or other regulated waste container that will be disposed of without incineration
- Mercury-free thermometers and sphygmomanometers
- Mercury-free lighting or low mercury fluorescents that are recycled
- Mercury fixatives and cleaning products
- Integrated pest management instead of pesticides
- Cleaning products that are the least toxic alternatives
- PVC-free IV bags, tubing, wristbands, mattress covers, shower curtains, upholstery, and binders
- Low VOC, PVC wall coverings and flooring
- Design that maximizes use of natural lighting
- Mercury-free thermostats and switches
- Rooms that are well ventilated
- Adequate staffing levels
- Needleless IV sets and other devices to prevent needlesticks
- Gloves that do not contain latex or vinyl
- A no-lift or team-lift policy
- A set of policies, practices, and educational programs that insure greener birth days for future generations

(Full text for "Green Birthdays" can be found at www.noharm.org/Green_Birthdays.pdf. The complete booklet can be ordered from Health Care Without Harm.)

Acting together, with each nurse taking just one step, we can create a powerful collective force to reduce the pollution created by the health care industry and thereby keep ourselves, our families, our patients, and our communities healthier.

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- Office of Pesticide Programs, Food Quality Protection ACT(FQPA) of 1996—*www.epa.gov/opppsps1/fqpa*
- EPA, United States Environmental Protection Agency—*www.epa.gov/seahome/mercury/Src/outmerc.htm*
- EPA, mercury *www.epa.gov/seahome/mercury/svc/ title.htm*
- National Fish and Wildlife Contamination Program—*www.epa.gov/ost/fish*
- Integrated Pest Management (IPM) in Schools—*www.epa.gov/pesticides/ipm/#fact*

Nursing World

- Nurses Attack Hidden Dangers of Health Care—*www.nursingworld.org/tan/novdec001/pollutio.htm*
- Workplace Issues, Occupational Safety and Health—*www.nursingworld.org/DLWA/OSH*
- Children's Environmental Health—*www.nursingworld.org/mods/mod250/CESAVERS.htm*
- Pollution Prevention in Health Care—*www. nursingworld.org/rnnoharm/*

Heath Care Without Harm

- Mercury Elimination— *www.noharm.org/library/docs/SHEA_proceedings_Mercury_Elimination_White_Pap.pdf*
- Neonatal Exposure to DEHP and Opportunities for Prevention in Europe *www.noharm.org/library/docs/ Neonatal_Exposure_to_DEHP-di-2-2ethylhexyl-phth.pdf*

Hospitals for a Healthy Environment

- H2E Programs: Become a Partner—*www.h2e-online.org/program/partners.htm*
- H2E Champion for Change Program—*www.h2e-online/program/champions.htm*
- Tools and Resources—*www.h2e-online.org/tools/index*

Other Federal Agency and NGO Resources

- Center for Food Safety and Applied Nutrition—*www.cfsan.fda.gov*
- Food and Drug Administration (FDA)—*www.fda.gov*
- National Institutes of Health (NIH) (mercury-free campaign)—*www.nih.gov/od/ors/ds/nomercury*
- Sustainable Hospitals four ways to find alternative products—*www.sustainablehospitals.org/cgi-bin/DB_Index.cgi*
- P2West, Western Regional Pollution Prevention Network for janitorial products pollution prevention project—*www.westp2net.org/Janitorial/jp4.htm*
- Office of New York's Attorney General Eliot Spitzer for Environment Protection Bureau—*www.oag.state.ny.us/environment/environment.html*
- The Capital Region Information Service of New York for New York coalition for alternatives to pesticides—*www.crisny.org/not-for-profit/nycap-nycap.htm*
- Chlorine Free Products Association—*www.chlorinefreeproducts.org*
- Commonwealth of Massachusetts for health care environmentally preferable purchasing (EPP) network information exchange bulletin—*www.state.ma.us/ ota/otapubs.htm#eppnet*
- The Nightingale Institute for Health and the Environment—*www.nihe.org*
- Physicians for Social Responsibility (PSR)—*www.psr.org*
- Envirohealthaction—*www.envirohealthaction.org*

Resources

Books and Other Publications

- Look for new *Environmental Health and Nursing* by B. Sattler and J. Lipscomb, with invited authors, published by Springer Publications (to be out in Fall 2002). See: *http://www.springerpub.com/*
- *In Harm's Way: Toxic Threats to Child Development*. Ted Schettler, Jill Stein, Fay Reich, Maria Valenti. Greater Boston Physicians for Social Responsibility. See web site: *www.gbpsr.org*
- "An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities and Guidebook for Hospital Waste Reduction Planning and Program Implementation" — (800) AHA-2626
- "Preventable Poisons: A Prescription for Reducing Medical Waste in Massachusetts" — (617) 292-4821
- "The Case Against Mercury: RX for Pollution Prevention"— (703) 548-5478
- "Guides to Pollution Prevention: Selected Hospital Waste Streams"—Publication # EPA/635/7-90/009
- "Protecting by Degrees: What hospitals can do to reduce mercury pollution," Environmental Working Group, available on the web: *www.ewg.org*

Videos

- "The Health Care Industry's Impact on the Environment: Strategies for Global Change" — Web site: *http://uvmce.ubm.edu:443/profprog.htm* or call (800) 639-3188 or (802) 656-2088
- "First Do No Harm" and "Mercury and the Healthcare Profession," both available as part of the ANA Pollution Prevention Kit (product # 9911; available from American Nurses Publishing: *www.nursesbooks.org*)
- "Moving Toward a Pollution Prevention Approach in the Healthcare Setting," produced by the University of Vermont (a new video is due out on managing health care's waste from the University of Vermont)

Organizations

- American Nurses Association — *www.nursingworld.org*
- Children's Environmental Health Network — *www.cehn.org*
- Environmental Health and Nursing, University of Maryland School of Nursing — *www.enviRN.umaryland.edu*
- Environmental Protection Agency — *www.epa.gov*
- Health Care Without Harm — *www.noharm.org*
- Food and Drug Administration (for information on DEHP and medical devices) — *http://www.fda.gov/*
- Hospitals for a Healthy Environment (H2E) — *http://www.h2e-online.org*
- Nightingale Institute for Environment and Health — *www.nihe.org*
- National Institute of Health (NIH) Mad as a Hatter — Mercury Elimination Program — *http://www.nih.gov/od/ors/ds/nomercury*
- National Toxicology Program, NIH — *http://ntp-server.niehs.nih.gov/*
- Physicians for Social Responsibility — *www.psr.org*
- Sustainable Hospitals / Lowell Center for Sustainable Production — *www.sustainablehospitals.org*
- Vermont Agency of Natural Resources for Mercury Information —— *www.anr.state.vt.us/dec/ead/ mercury/merc.htm*

Environmental Health in the Health Care Setting

INSTRUCTIONS

Read the article and complete the POST-TEST ANSWER SHEET below. Check your answers and grade yourself using the FEEDBACK SECTION on the next page. Each answer is worth 6.66 points. If you receive a grade below 75 percent, please re-read the article and retake the test until you successfully score 75 percent or better. Complete the EVALUATION OF THE INDEPENDENT STUDY MODULE and the CE PROGRAM REGISTRATION (on the back).

This exam can also be taken online at www.NursingWorld.org/CE to obtain your ANA continuing education contact hours certificate.

1) Approximately how much hospital waste is generated annually?
a. A half million tons
b. A million tons
c. Two million tons
d. Over two million tons

2) Nurses can have an influence on waste management but first they must understand the makeup of hospital waste. The largest single component in hospital waste is:
a. Food waste
b. Plastics
c. Paper
d. Infectious waste

3) The most commonly used plastic in the health care industry is:
a. Polystyrene
b. Polyvinyl chloride
c. Styrofoam
d. Polypropylene

4) The most common source of information regarding human health effects associated with environmental chemical exposures is from:
a. Occupational exposures to hazardous chemicals
b. Animal-modeled toxicological studies
c. Accidental releases of hazardous chemicals
d. Pharmacological studies

5) What form of mercury pollution presents the greatest risk to human health?
a. Methylmercury
b. Mercury oxides
c. Elemental mercury
d. Inorganic mercury

6) Mercury contamination is a serious threat to children and pregnant women in which of the following foods?
a. Red meat
b. Breast milk
c. Fish
d. Dairy products

7) DEHP (di(2-ethylhexyl)phthalate) comprises what percent of PVC plastic?
a. <5%
b. 10%
c. 20—40%
d. >50%

8) Dioxin is an unintentional product of combustion when chlorinated compounds are incinerated. Dioxin is:
a. Biodegraded in the environment when exposed to sunlight.
b. A product that has several useful functions.
c. A family of chemicals that is toxic and bioaccumulative.
d. Believed to have a half-life of 50 years in the human body.

9) What percent of human exposure to dioxin comes from food?
a. 1%
b. 10%
c. 90%
d. 100%

10) The Industrial Hygiene Hierarchy of Controls is a:
a. Framework for categorizing methods of health and safety measures.
b. Model for understanding the effectiveness of disinfectants.
c. Rule for selecting sterilants in health care settings and schools.
d. New Occupational Safety and Health Regulation for cleaning products.

11) Two chemicals used for disinfection and sterilization that pose significant health threats are:
a. Alcohol and gluteraldehyde
b. Gluteraldehyde and ethylene oxide
c. Ethylene oxide and PVC
d. DEHP and PVC

12) Integrated Pest Management (IPM) calls for the:
a. Use of several chemical solutions in combating insect infestations
b. Employment of several disciplines when using pesticides
c. Banning of chemical pesticides used in hospitals and schools
d. Combination of traps, physical barriers, and chemical agents, as necessary

13) The 1997 ANA "Reduction of Health Care Production of Toxic Pollution" Resolution calls for all of the following, except:
a. Promotion of alternatives to products made from PVC
b. Support for mercury-free health care delivery and facilities
c. Support for non-incineration methods of medical waste disposal
d. Support for the reduction of DEHP use

14) Nurses are playing a key role in improving environmental health risks in the health care sector. Which of the following organizations has the ANA partnered with to form Hospitals for a Healthy Environment (H2E)?
a. American Hospital Association, Health Care Without Harm, and OSHA
b. Health Care Without Harm, OSHA, and EPA
c. American Hospital Association, EPA, and Health Care Without Harm
d. EPA, OSHA, and Health Care Without Harm

15) There are several pollutants emitted during the process of incineration that pose health risks. Dioxin is one of the pollutants and is known to be associated with:
a. Visual impairment
b. Endocrine dysfunction
c. Osteoporosis
d. Scleroderma

POST-TEST ANSWER SHEET

Directions: Please circle the correct answer. ***Answers on back of page.***

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D
11.	A	B	C	D
12.	A	B	C	D
13.	A	B	C	D
14.	A	B	C	D
15.	A	B	C	D

Environmental Health in the Health Care Setting

1. **D is correct.** An estimated 2.4 million tons of waste is created annually by the health care industry.
2. **C is correct.** Paper comprises about 50% of health care waste.
3. **B is correct.** Polyvinyl chloride is the most common form of plastics used in the health care industry.
4. **B is correct.** The vast majority of our knowledge regarding the toxicity of chemicals comes from animal and in vitro studies. We then extrapolate the information to estimate human health risk.
5. **A is correct.** Methylmercury, the organic form of mercury created in the environment poses the greatest risk to human health.
6. **C is correct.** Due to the mercury contamination in our water (both fresh and ocean) fish have become sufficiently contaminated to pose a serious health threat.
7. **C is correct.** DEHP is a significant portion of most PVC plastic: 20—40%
8. **C is correct.** Dioxin is a family of toxic chemicals that bioaccumulate in the environment.
9. **C is correct.** Approximately 90% of human exposure to dioxin comes from food, specifically in the form of beef, fish, and dairy products.
10. **A is correct.** The hierarchy provides a framework for categorizing methods of health and safety measures.
11. **B is correct.** Ethylene oxide, a cold sterilizing agent, is a carcinogen and a reproductive toxin that can cause miscarriage; glutaradehyde is a potent skin irritant and sensitizer known to trigger asthma.
12. **D is correct.** Integrated pest management is a philosophy and system of managing pests that provides a framework for removing life support systems for pests (food, water, and nesting space) along with least hazardous methods such as traps and sticky tapes before moving on to chemical solutions.
13. **D is correct.** DEHP concerns are not raised in the 1997 ANA resolution. It is important to note that the ANA resolution was passed before the nursing community was made aware of the issues involving DEHP, therefore there is no language regarding this new and emerging issue.
14. **C is correct.** H2E was born out of a landmark agreement between the EPA and AHA in 1998 to eliminate mercury from the health care waste stream and reduce total volume of waste by one third by 2005 and by half by 2010. The two newest sponsors of H2E are now the American Nurses Association and the Health Care Without Harm campaign.
15. **B is correct.** Endocrine dysfunction is one of the health effects associated with dioxin exposure. Dioxin exposure is also linked to neuro, immune, and behavioral dysfunction; cancer; altered glucose tolerance; and endometriosis.

If you have a question about the incorrect answers or want a copy of the incorrect rationales, please call (800) 274-4262, ext. 7233.

EVALUATION OF THE INDEPENDENT STUDY MODULE

Directions: Please circle the appropriate number, which indicates your rating of each statement. Ratings range from 1=low/poor to 5=high/excellent.

	Low or Poor			High or Excellent		Not Applicable
1. To what extent have you achieved each objective of this independent study?						
Objective 1: Describe the major environmental health threats posed by the health care sector.	1	2	3	4	5	N/A
Objective 2: Identify three chemicals that may affect children's environmental health associated with the health care sector.	1	2	3	4	5	N/A
Objective 3. Explain the nurse's role in taking action to improve the environmental health risks in the health care sector.	1	2	3	4	5	N/A
Objective 4. Specify three resources that can provide more guidance in improving environmental health in the health sector.	1	2	3	4	5	N/A
Objective 5. Discuss the goals of the American Nurses Association's Resolution on Pollution Prevention.	1	2	3	4	5	N/A
Objective 6. Describe two products/processes that are employed in hospitals which create health risks.	1	2	3	4	5	N/A
Objective 7. List three health effects associated with incineration.	1	2	3	4	5	N/A
Objective 8. Name three indicators of children's health that may be related to environmental health risks.	1	2	3	4	5	N/A
2. To what extent did the content relate to the study objective?	1	2	3	4	5	N/A
3. To what extent was the teaching method and aids appropriate and used effectively?	1	2	3	4	5	N/A
To what extent do you feel this independent study module will be:						
4. Essential to your area of nursing practice.	1	2	3	4	5	N/A
5. Useful to your area of nursing practice.	1	2	3	4	5	N/A

6. Total amount of time in minutes it took you to enter on line www.nursingworld.org/ce and register for one of the free independent study modules: _____
7. Total amount of time in minutes it took you to complete this independent study module, "Environmental Health in the Health Care Setting": _____

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Checks should be made payable to ANA. Fees are non-refundable. NY and CA residents must add sales tax.

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6. Social Security Number: _____
7. Are you a member of an ANA constituent member association (CMA)? __yes __no
   If yes, which state? _____
8. State of RN License: _____ RN License #: _____
9. State in which you are currently practicing: _____
10. Today's Date: _____

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AMERICAN NURSES ASSOCIATION

Evaluation of the Continuing Education Independent Study:
"Environmental Health in the Health Care Setting"
Author: Barbara Sattler, DrPH, RN
Published in TAN issue: March/April 2002
Program Code LD: 20204028 / Contact Hours: 3.3
Processing Fee: $14 CMA members/$19 non-CMA members

Inquiries or Comments: If you have any questions about this or any other ANA/ANF Independent Study Module, please call our toll-free number (800) 274-4262 and ask for extension 7233. For questions related to other ANA continuing education activities, please contact RoAnne Dahlen-Hartfield, DNSc, RN, by asking for extension 7106. Duplicate Nursing Continuing Education Certificates are available. All requests for duplicate certificates must be made in writing and include a check for $5 per certificate made payable to ANA.

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Comments welcome! What other topics would you like to see developed into an independent study module? Please attach additional pages.