GLOBAL GREEN and HEALTHY HOSPITALS

Chemicals

GGHH guidance document series

Provides guidance for hospitals and others working on the GGHH safer chemicals goal

GGHH guidance document series

Global Green and Healthy Hospitals (GGHH) is creating guidance documents for each of the 10 GGHH goal areas. These documents are intended to assist member hospitals and health systems in reducing their environmental footprint and promoting environmental health. This document provides guidance for hospitals and others working on the GGHH safer chemicals goal.

Guidance documents are designed as interconnected pieces of a larger framework that includes action items in the GGHH agenda, self-assessment checklists, benchmarking tools, associated case studies and resources, and tools (still in development) to help members measure progress over time.

These documents are available to members via GGHH Connect and downloadable in PDF format. They are meant to be participatory, living documents. GGHH seeks feedback and suggestions for actions, examples, case studies, and links so guidance evolves based on the experience and input of our members.

About the safer chemicals guidance document

The health care sector is one of the largest consumers of chemicals and materials, some of which are well documented to pose serious threats to health and the environment. Although the sector's mission is to protect human health, these harmful chemicals and materials can contribute to the burden of disease and threaten ecological systems on which we depend for life and health.

Products used in health care have the potential to harm human health and the environment during production, use, and disposal. Toxic chemicals generated during the life cycle of products have contaminated humans and the environment worldwide. Nearly all nations suffer an epidemic of chronic diseases with strong links to environmental factors. The manufacture, use, and disposal of hazardous chemicals has created a crisis that poses a global threat to human rights. Inequities in the distribution of these hazards can be exacerbated by socio-economic factors. Coupled with climate change, chemical contamination can exacerbate and accelerate impacts to the ecosystem and human health that threaten the basis of all life.

Even before birth, people encounter a barrage of toxic chemicals that can impact normal childhood development and health later in life. The health consequences of exposure to toxic chemicals are disproportionately borne by people with low incomes. Populations vulnerable to hazardous chemicals and materials used in health care include patients, clinicians, environmental services workers and other employees in the health care setting, factory workers that manufacture products, workers in waste disposal facilities, and people who live near mining, manufacturing, or waste disposal sites. Research has shown that health sector employees may be more at risk than the general public, reporting one of the highest rates of adult asthma relative to all major occupational groups and showing a greater risk of developing chronic respiratory illnesses. Health care clinicians and technicians are at risk.

The safer chemicals guidance document includes a brief overview of each priority area along with a set of tools to reduce the use of hazardous chemicals and materials and improve the health and safety of patients, workers, visitors, and the community.

This is not intended to be a systematic evidence review nor a comprehensive treatment of all potential sustainability challenges, but rather a toolkit focused on some of the most important and widely recognized sustainability issues in health care.

Acknowledgments

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Portions of the following documents were excerpted (in some cases extensively) in this guidance document.

- **Factsheet** | Hazardous chemicals in medical devices: Bisphenol A (BPA) (April 2013) Authors: Health Care Without Harm (HCWH)
- **Factsheet** | Hazardous chemicals in medical devices: Phthalates (May 2013) Authors: Health Care Without Harm
- **Factsheet** | Ten-step guide to implementing an integrated pest management program. Authors: Practice Greenhealth
- **Factsheet** | Sustainable procurement quick guides: Gloves; safer surface disinfection; routine hand hygiene; safer instrument disinfection; PVC medical devices (2020) Authors: Health Care Without Harm
- **Guide** | PGH hand soaps challenge and get-started guide Published by Health Care Without Harm and Practice Greenhealth (2018) Authors: Tracey Easthope, Rachel Gibson, and Ted Schettler
- **Guide** | Chemicals substitution and management in the health care sector: A four-hospital, multi-country project in the Philippines and Argentina Health Care Without Harm for SAICM (December 2013) Authors: Health Care Without Harm
- **Guide** | Chemical safety, substitution, and management training for health workers Published by SAICM and KEMI
- **Guide** | Sustainable procurement in health care guide (July 2020) Published by Health Care Without Harm, Practice Greenhealth, and GGHH
- **Report** | Antimicrobials in hospital furnishings: Do they help combat COVID-19? Published by Health Care Without Harm (August 2020) Author: Ted Schettler
- **Report** | Practice Greenhealth environmental excellence awards partners for change award, chemicals (2019) Authors: Practice Greenhealth and Health Care Without Harm
- **Report** | Antimicrobials in hospital furnishings: Do they help reduce health care-associated infections? (March 2016) Author: Ted Schettler
- **Report** | Polyvinyl chloride in health care: A rationale for choosing alternatives (January 2020) Author: Ted Schettler
- **Report** | Health Care Without Harm: Promoting safer disinfectants in the health care sector SAICM 2.0 final report (2020)

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How to start

Knowing where to start is often the hardest part. We've compiled a few ideas to help you begin a conversation within your organization. Eventually addressing chemicals of concern should happen in the context of a robust sustainable procurement program. For a summary of issues of concern in health care, see appendix 1. The subsequent chapters offer guidance on priority product categories identified by GGHH. For a comprehensive guidance document to support procurement work, see the Sustainable procurement in health care guide.

Many different approaches and starting points can work depending on your facility. It's important to start somewhere.

- Find a champion within your facility who believes in sustainability and is already doing work and learn from their experience.
- Identify others tasked with working on these issues and learn about their priorities and projects. Identify what is going well and learn how changes were implemented.
- Approach leadership for support to explore sustainability challenges in your area or department.
- With management support, design and offer a survey to hospital staff to gain input on concerns related to hazardous chemical or product use, as well as ideas to reduce hazards.
- Find an obvious and important problem in your facility that could be addressed by sustainable procurement and build support to work on that problem.
- Learn about the purchasing process in your facility, including where purchasing decisions are made and how and when to influence decisions.
- Look at occupational health logs to evaluate major issues of concern or areas of needed improvement. If your facility does not have a log, consider creating one.
- Identify a smaller opportunity for sustainable procurement that might be an easy win and build momentum and competence.
- Use the priorities identified in this guide and the Health Care Without Harm high-priority product category list (see annex 4 for a longer list) to identify priority product categories that have lots of resources and case studies to support your effort.
- Consider conducting a pilot to build support and momentum for a product change.
- Engage in a priority-setting exercise to identify priorities for your facility or department. One tool to help prioritize products or services within your institution can be found in the procurement guide (see annex 3).
- Consult the elements of an action plan for an implementation roadmap (see annex 4).

For further discussion, see Health Care Without Harm and Practice Greenhealth's sustainable procurement in health care guide and elements of an action plan, as well as Health Care Without Harm's sustainable procurement resources.

Important concepts

Some important concepts to consider when working toward safe chemical substitution and management in the health care setting include chemical identification and labeling, a hierarchy of controls approach to hazards, and complementary substitution and alternatives assessment.

Chemical identification, labeling, and communication

Identifying and labeling chemicals is a fundamental building block of health, safety and sustainability. This practice supports the development of a safety culture at your facility, helps assure patient and employee health and safety, and facilitates proper disposal of products to protect the community. Identifying and labeling chemicals also helps with the prioritization of hazards. Many countries require labeling using the Globally Harmonized System (GHS) of classifying and labeling chemicals, but it may not be consistently practiced or communicated. Any program to ensure the safe use of chemicals should include identifying hazards (including classification according to a credible classification system); clearly labeling chemical and material hazards (including safe handling instructions); communicating pertinent information consistently and clearly at point of use and in storage; and eliminating and reducing hazards wherever possible. Leaders should institutionalize and prioritize these practices throughout the organization.

Tools and resources

Database | International Labor Organization/WHO International chemical safety cards provide essential safety and health information on chemicals.

Guidance | OSHA Guide to the globally harmonized system of classification and labeling of chemicals (GHS)

Website | GHS Globally harmonized system of classification and labeling of chemicals

Website | GHS Globally harmonized system implementation by country

Substitution and alternatives assessment

Substitution or informed substitution means replacing hazardous chemicals with demonstrated safer alternatives to protect public health and the environment. In 2010, the U.S. Environmental Protection Agency defined informed substitution as:

> *A considered transition from a chemical of particular concern to safer chemicals or non-chemical alternatives. The goals of informed substitution are to minimize the likelihood of unintended consequences, which can result from a precautionary switch away from a chemical of concern without fully understanding the profile of potential alternatives, and to enable a course of action based on the best information – on the environment and human health – that is available or can be estimated.*

Functional substitution emphasizes the need to substitute a particular function or service that the chemical or material provides rather than finding a drop-in chemical replacement. This process involves exploring a range of molecular, material, design, and systems changes that can meet a particular function, creating opportunities for innovation in product and building design. For example, rather than substituting one flame retardant for another, a functional substitution approach would look at alternative options to achieve the function of flame retardancy. These options might include using alternative designs that eliminate flammable materials; separating flammable materials from ignition sources; using barrier materials between flammable materials and an ignition source; reevaluating the need for the function (ie not all products need a flame retardant); installing sprinklers in a building to eliminate the need for a flame retardant; or evaluating the level of performance based on the evidence.

An **alternatives assessment** is a step-defined process that occupational health specialists, manufacturers, product designers, businesses, governments, health care purchasers, supply chain managers, and others can use to make more informed decisions about the substitution of toxic chemicals in products, processes, or institutions. An alternatives assessment decreases risk by reducing hazards, avoiding regrettable substitutions, and integrating occupational safety and health and environmental considerations into product selection. Key principles include a focus on function first instead of a particular chemical; a central focus on hazard reduction; and consideration of the necessity of a chemical.

Alternatives may include drop-in substitutes; changes in production processes; changes in product design; changes in how functions are performed; non-chemical solutions; or new systems of consumption.

Tools and resources

Guidance | Interstate Chemicals Clearinghouse Alternatives assessment guide (2017)

Guidance | National Academies Framework to guide selection of chemical alternatives (2014)

Training syllabus | SAICM-KEMI Chemical safety, substitution, and management training for health workers

Website | European Chemicals Agency How to substitute: A step-by-step guide to substitution

Website | OECD Substitution and alternatives assessment toolbox

Website | Interstate Chemicals Clearinghouse Chemical hazard assessment database enables users to search for GreenScreen and quick chemical assessment tools.

Website | Clean Production Action GreenScreen is a method for comparative chemical hazard assessment that can be used for identifying chemicals of high concern and safer alternatives.

Website | Health and Safety Executive of UK Substitution basics

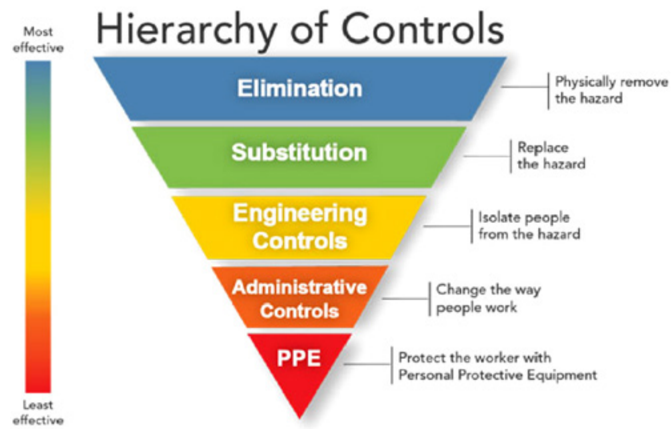
Website | German Federal Institute for Occupational Safety and Health Subsport is a free, multilingual platform for information exchange on alternative substances and technologies.

For product-specific information on alternatives, see the chapters below.

Hierarchy of controls

Occupational safety and health professionals use a framework called the hierarchy of controls to reduce workplace hazards. It is a widely accepted system promoted by most safety organizations. **The hierarchy places the highest value on completely eliminating a hazard rather than relying on workers to reduce their exposure**.

The hazard controls in the hierarchy are, in order of decreasing effectiveness:



Source: The National Institute for Occupational Safety and Health (NIOSH)

Elimination: Eliminating the hazard by physically removing it is the most effective hazard control. Hazards can be eliminated by redesigning an activity so hazardous chemicals are not required or eliminating the need for chemicals through prevention as with Integrated Pest Management.

Substitution: Substitution refers to the replacement of a hazardous material or process with one that is less hazardous. Substitution can be a drop-in replacement or include product redesign so the hazard isn't required. Minimization involves the reduction of a hazard rather than complete elimination.

Engineering controls: Engineering controls involve making changes to the work environment to reduce exposure to chemical hazards. A common example is fume hoods. This approach is preferred when it is impossible to eliminate the hazard completely because engineering changes can be institutionalized and made permanent and do not rely on employee behavior.

Administrative and work practice controls: Administrative controls are policies and procedures that modify workers' schedules and tasks in ways that minimize exposure to hazards. Examples include developing a chemical hygiene plan or standard operating procedures such as pouring instead of spraying cleaning chemicals on surfaces (in order to reduce inhaled exposures). This intervention relies on worker behavior change, making it less robust.

Personal protective equipment (PPE): PPE is the least effective method for protecting workers from hazards. PPE includes masks, gloves, or other protective equipment to reduce exposure. PPE should be used in addition to other methods or if there are no other effective ways to control the hazard. This intervention relies on worker behavior change and should be the last line of defense.

Tools and resources

Website | CDC NIOSH hierarchy of controls

Priority chemicals and materials of concern in health care

Mercury-containing medical products

Rationale

Mercury is widely used in health care, and the World Health Organization has identified it as one of the top 10 chemicals of major public health concern. The United Nations Environment Programme (UNEP) has identified the adverse effects of mercury pollution as a serious global environmental and human health problem. The UNEP Governing Council has targeted reducing methylmercury accumulation in the global environment as a major global priority.

Mercury can be manufactured or occur in different forms that vary in toxicity and bioavailability. In metal form, mercury can rapidly vaporize at ambient temperatures and be dispersed and inhaled when released indoors. When released to the environment, mercury persists and circulates between air, water, sediments, soil, and biota. Mercury can be deposited locally or transported long distances. When metallic mercury ends up in water bodies and wetlands, naturally occurring bacteria in the sediment transform it into methylmercury, a more toxic compound that can build up in fish tissue. Fish and shellfish are the main sources of methylmercury in the human diet.

Methylmercury is highly toxic to humans and wildlife, with impacts on the brain, nervous system, kidneys, digestive and immune systems, lungs, skin, and eyes. It is readily absorbed from the intestinal tract and in pregnant women easily crosses the placenta, where impacts on fetal brain development are a particular concern. Chronic, low-dose prenatal exposure to methylmercury as a result of maternal consumption of fish has been shown to cause neurotoxicity in children. Neurotoxic impacts include poor performance on neurobehavioral tests, particularly attention, fine-motor function, language, visual-spatial abilities like drawing, and verbal memory. Among certain subsistence fishing populations, between 1.5 per 1,000 and 17 per 1,000 children have shown cognitive impacts caused by consumption of fish containing mercury.

Mercury has been detected in human blood, urine, milk, and hair. Biomonitoring data routinely collected by the U.S. Centers for Disease Control and Prevention (CDC) show that approximately 6 percent of women of reproductive age are exposed to mercury at or above the reference dose, representing a public health threat.

Mercury is present in a wide variety of health care products, including thermometers, sphygmomanometers, dental amalgam, laboratory chemicals and preservatives, cleaning agents, and various electronic devices such as fluorescent lamps and computer equipment. Some of these devices can break or leak, exposing health care workers to the metal and potentially contaminating the environment. Costs of spills have ranged from several thousand dollars to hundreds of thousands of dollars. Mercury spills also can pose a threat to workers. In one Ohio study, mercury from three broken thermometers in an office approximately 10 square feet in size led to vapors three times the limit permitted by the U.S. Occupational Safety and Health Administration.

Dental amalgam is used to fill cavities caused by tooth decay. Approximately half of dental amalgam is elemental mercury by weight. In 2016, the United Nations Environment Programme and the World Alliance urged governments around the world to phase down the use of dental amalgam. Norway and Sweden have completely prohibited its use. Since July 2018, dental amalgam cannot be used in any EU country to treat milk teeth and is prohibited for children younger than 15 and pregnant or breastfeeding women, except when deemed strictly necessary. In 2020, the U.S. FDA recommended against using mercury dental amalgam in certain high-risk groups.

International treaty on mercury elimination

The Minamata Convention on Mercury of 2013 is a global treaty to protect human health and the environment from anthropogenic emissions and releases of mercury. The major highlights of the convention include restrictions on the manufacture, import, or export of mercury-added products; a ban on new mercury mines; the phase out of existing mines; the phase out and phase down of mercury use in a number of products and processes; control measures on emissions to air and releases to land and water; and regulation of the informal sector of artisanal and small-scale gold mining. The convention also addresses interim storage of mercury, disposal once it becomes waste, and contaminated sites.

WHO and Health Care Without Harm global mercury-free health care initiative

The World Health Organization and Health Care Without Harm global initiative was a component of the UNEP mercury products partnership led by the United States Environmental Protection Agency. The objective of the initiative was to reduce the use of mercury-containing fever thermometers and sphygmomanometers by at least 70% and shift to accurate, affordable, and safer non-mercury alternatives. See the initiative for more information.

Other uses

Mercury is also used in industrial processes that produce chlorine and sodium hydroxide (mercury chlor-alkali plants), vinyl chloride monomer for polyvinyl chloride production, and polyurethane elastomers. It is extensively used to extract gold from ore in artisanal and small-scale gold mining. It is contained in products such as electrical switches (including thermostats), relays, measuring and control equipment, energy-efficient fluorescent light bulbs, and some batteries. It is used in laboratories, cosmetics, pharmaceuticals (including vaccines as a preservative), paints, and jewelry. Mercury is also released from some industrial processes, such as coal-fired power and heat generation, cement production, mining, and other metallurgic activities such as non-ferrous metals production, as well as incineration of many types of waste.

Key considerations

- It is important to inventory all mercury sources at your facility and prioritize elimination of the most important ones (see chart below).
- Digital thermometers perform well but certain considerations are important:
  - Digital thermometers can be as accurate as mercury thermometers. Those that conform to international standards have the degree of precision required in medical care.
  - Standard-setting organizations like ASTM International have developed protocols to help the health care community identify accurate alternatives.
  - It is imperative that the health care sector and governments guarantee thermometers acquired from manufacturers abide by independently certified ASTM testing techniques and protocols (or other internationally recognized procedures) to ensure accuracy.
  - Some digital thermometers must be calibrated. Some manufacturers recommend having the precision of the temperature sensor tested regularly by an authorized laboratory.
- Aneroid blood pressure devices perform well but should be periodically maintained and calibrated.

Mercury hazard summary and alternatives chart

Hazard summary	Product category	Select alternatives
Mercury is a persistent and potent neurotoxicant that can harm the brain, kidneys, and liver. Mercury is toxic to unborn children. Mercury can contaminate the food web.	Thermometers	Mainly digital or electronic, alcohol, galinstan
	Blood pressure monitors	Mainly aneroid (mechanical dial or digital) – electronic, oscillometric
	Thermostats	Electronic

Exposed populations: • Health care workers • Community members living in production and disposal areas • Workers engaged in manufacturing • Wildlife and aquatic life	Batteries	Mercury-free/rechargeable batteries, lithium, zinc air, alkaline
	Amalgam dental fillings	Composite resin, glass ionomer, porcelain, and gold
	Manometers	Electronic
	Gastrointestinal tubes, esophageal devices, Cantor and Miller-Abbott tubes	Tungsten-filled dilators, products w/ tungsten tubing, Anderson AN-20
	Fluorescent tubes	Bulbs with low Hg content, LED lights
	Lamps and lighting devices including lamps in LCD displays in medical devices and office equipment	LEDs, non-mercury lamps
	Mercury switches	Electronic switches

Tools and resources: Alternatives

- **Guidance** | UNDP-GEF Guidance on maintaining and calibrating non-mercury clinical thermometers and sphygmomanometers: UNDP-GEF global health care waste project (2013)
- **Guidance** | WHO replacement of mercury thermometers and sphygmomanometers in health care (available in Spanish) (2011)
- **Report** | HCWH Mercury elimination guide for hospitals (available in English, Spanish, Portuguese, and Chinese)
- Infographic | HCWH Towards mercury-free dentistry in Europe (2019)
- **Report** | U Mass Lowell Eliminating mercury in health care: A workbook to identify safer alternatives. Created with the Institute for the Development of Production and the Work Environment (IFA) in Quito, Ecuador and the University of Sonora, Department of Chemical and Biological Sciences in Hermosillo, State of Sonora, Mexico (also in Spanish) (2012)
- **Report** | HCWH Mercury in dental amalgam and resin-based alternatives: A comparative health risk evaluation (2012)
- **Powerpoint** | UNDP-GEF Global health care waste project: Non-mercury alternatives
- **Website** | HCWH global website: Resources on alternatives
- **Website** | HCWH mercury resource pages: global; US and Canada; in Spanish

Tools and resources

- **Fact sheet** | HCWH Moving towards a phase-out of dental amalgam in Europe (2018)
- **Fact sheet** | HCWH Q&A: Phasing out mercury thermometers and blood pressure devices (2013)
- **Fact sheet** | WHO-HCWH Mercury-free 2020 (2013)
- **Fact Sheet** | HCWH Instruments, products, and laboratory chemicals used in hospitals that may contain mercury (2001)
- **Fact sheet** | HCWH Managing small mercury spills (2006)
- **Guidance** | UNDP-GEF Guidance document on the cleanup, transport, and storage of mercury waste in health care. UNDP, GEF Global healthcare waste project

- **Guidance** | FDA recommendations for certain high-risk groups regarding mercury-containing dental amalgam (2020)
- **Guidance** | WHO Developing national strategies for phasing out mercury-containing thermometers and sphygmomanometers in health care (2015)
- **Guidance** | HCWH Guide for elimination of mercury from health care establishments Includes inventory, policy, step by step guide, facility-wide inventory (Spanish, English, Portuguese, and Chinese) (2011)
- **Guidance** | UMass Lowell ABCs of mercury reduction: A how-to manual for designing, implementing, and monitoring mercury reduction in your hospital. Created with the University of Massachusetts Lowell, USA The Institute for Development of Production and the Work Environment (IFA), Quito, Ecuador, The University of Sonora, Hermosillo, Mexico] (2010)
- **Guidance** | UNDP-GEF Guide for cleaning, temporary or intermediate storage, and transport of mercury waste from health facilities (available in Spanish)
- **Guidance** | WHO Information on mercury in health care, related WHO activities, resources, and risk assessment methodologies
- **Infographic** | HCWH Mercury: A major environmental and public health concern (2016)
- **Policy** | PGH Sample mercury elimination and management policy (2012)
- **Report** | European Commission Report on on the use of mercury in dental amalgam and products (2020)
- **Report** | HCWH and WHO Toward the tipping point: WHO-HCWH global initiative to substitute mercury-based medical devices in health care (2010)
- **Report** | HCWH Mercury in Argentine dentistry (2010)
- **Report** | European Environmental Bureau Turning up the pressure: Phasing out sphygmomanometers for professional use (2009)
- **Report** | HCWH-European Environmental Bureau EU mercury phase out in measuring and control equipment (2009)
- **Report** | HCWH Global movement for mercury-free health care (2007)
- **Website** | HCWH Sustainable procurement resources
- **Website** | WHO Mercury elimination and phase-out guidance
- **Website** | HCWH mercury resource pages: global; US and Canada; in Spanish
- **Website** | US EPA Mercury (available in multiple languages)
- **Website** | US EPA Products that may contain mercury

Case studies

Argentina: Austral University Hospital (in Spanish)

Argentina: Hospital Zonal General de Agudos Elimination of mercury thermometers and sphygmomanometers (available in Spanish)

Argentina: How a hospital in Buenos Aires, Argentina, eliminated mercury devices and reported significant savings when it replaced all of its thermometers (2006)

Brazil: Río de Janeiro's Instituto Nacional de Traumatologia e Ortopedia Jamil Haddad Substitution of mercury-based medical devices (available in Portuguese) (2013)

Brazil: 116-bed Hospital São Luiz in São Paulo found that maintenance and calibration of digital and aneroid thermometers and sphygmomanometers cost significantly less than maintaining mercury devices (2007)

Global: Lessons from countries phasing down dental amalgam use (2016)

India: Moving towards mercury-free health care: Substituting mercury-based medical devices in India, Toxics Links (2009)

Mexico: Mexico Federal District Government Ministry of Health Substituting mercury-based devices in a public health system (available in Spanish) (2013)

Mexico: 250-bed Federico Gomez Children's Hospital will save a minimum of U.S. $10,000 over six years by replacing mercury thermometers (2007)

Nepal: Mercury-free health care system development in Nepal (2011)

Philippines: Mercury in health care: Philippines conference (2006)

Sweden: National plan of dental amalgam phase out: Sweden has had a general mercury ban since 2009 and has already phased out mercury dental amalgam (2019)

Taiwan: Taipei Medical University Hospital Chemicals used reduction and management

Sterilants and disinfectants

Rationale

Sterilants and disinfectants are widely used in health care and are essential for safe clinical care. They help prevent cross contamination and the spread of pathogens and disease, including hospital-acquired infections (HAI). Active ingredients that are so effective at disinfecting surfaces, medical devices, materials, and skin also pose a variety of hazards to human health and the environment. Biocidal agents are necessarily toxic to living organisms, so they can contribute to occupational health hazards, environmental and community threats, and the spread of antimicrobial resistance (AMR).

The most common occupational health impacts caused by disinfectants are respiratory issues (sensitization or irritation), chronic obstructive pulmonary disease, skin problems, eye irritation, and migraines or other neurologic symptoms. Some disinfectant ingredients can be allergenic and have been identified as carcinogenic, mutagenic, and repro-toxic or endocrine disrupting. Common ingredients are among the most toxic. For example, glutaraldehyde can cause allergic skin reactions and asthma symptoms, and formaldehyde can cause cancer.

Many sterilants and disinfectants may have adverse effects on water systems due to aquatic toxicity or low biodegradability. Sterilants and disinfectants entering wastewater from hospital discharges can disturb wastewater treatment and the microbial ecology in surface waters. There is also evidence that some multi-drug resistant pathogens are growing resistance to several disinfectants commonly used to prevent them from spreading. For example, bacteria such as enterococcus faecium and staphylococcus aureus are resistant to solutions with hydrogen peroxide at 3%, and listeria monocytogenes are becoming more tolerant to benzalkonium chloride. A recent study compared the occurrence of AMR between surfaces in highly controlled clinical settings and other “less clean” environments. Results showed that controlled environments had as many bacteria but less variety of species, and those species were more difficult to target with antimicrobial drugs. Disinfectants may also contribute to antibiotic resistance.

Sterilants and disinfectants are used for the following:
- Instrument disinfection
- Surface disinfection
- Antisepsis/pre-operative washing
- Hand hygiene
- Material additives to confer antimicrobial properties in furnishings, textiles, and paints
- Preservatives

The use of sterilants and disinfectants for instrument and surface disinfection is the focus of this section. See the hand hygiene section for additional information.

Sterilization and disinfection chemicals are categorized by their potency and achieve different aims:
- Sterilization is the complete removal or destruction of all forms of microbial life (including fungi and bacterial spores). Items must first be cleaned before sterilization to be effective. Sterilization is used for critical items like surgical equipment, central line catheters, urinary catheters, and IV fluids.
- Disinfection eliminates most microorganisms, with the exception of bacterial endospores. Items must be clean for effective disinfection. Disinfection is further categorized into high, intermediate, and low-level disinfection
- Cleaning is the removal of visible soil (organic and inorganic material) from objects and surfaces and is accomplished manually or mechanically using water with detergents or enzymatic products. Thorough cleaning is essential before high-level disinfection and sterilization because inorganic and organic materials that remain on surfaces interfere with the effectiveness of these processes. Decontamination removes pathogenic microorganisms from objects so they are safe to handle, use, or discard.

Medical devices are classified according to the risk involved in their use:
- Critical items contact sterile tissues or cavities and the vascular system. They must be sterilized.
- Semicritical items contact a patient’s intact mucosa, such as anaesthetic breathing circuits and endoscopes. They must undergo high-level disinfection. Some semicritical items can undergo intermediate level disinfection.
- Noncritical items contact intact skin. They must undergo low-level disinfection. These include bedspreads, blood pressure devices, incubators, and tableware.

While sterilants and disinfectants are critical for safety in a clinical setting, it is important to use the appropriate level of sterilization or disinfection depending on the situation. The least toxic yet effective products should be chosen to reduce the human health and environmental downsides of their use and disposal. By conducting a thorough assessment of the use of these chemicals in your facility, it is possible to reduce their use by:

- identifying categories of infection risk (critical, semicritical, or noncritical) and matching each to the appropriate sterilants and disinfectants.
- identifying areas where sterilants and disinfectants are being overused and can safely be minimized or eliminated through collaboration across infection prevention and environmental or custodial services.

The chart below reviews some commonly used sterilants and disinfectants for medical devices and surface disinfection and identifies safer alternatives.

Off-site sterilization

Some devices are sent off site for sterilization. Ethylene oxide (EtO) is a common sterilant used in off-site treatment, and is currently used to sterilize about 50% of medical devices in the United States. Once released from a treatment facility, ethylene oxide can last in the air for weeks and be transported with prevailing winds. Ethylene oxide is a known human carcinogen. Evidence in humans indicates that long-term exposure increases the risk of cancers of the white blood cells, including non-Hodgkin's lymphoma, myeloma, and lymphocytic leukemia, as well as breast cancer in females. EtO can severely irritate and burn the skin, eyes, and lungs. In a review by the Environmental Protection Agency, ethylene oxide was the chief chemical responsible for most of the 109 communities found to exceed cancer risks from air pollution sources. More than 600,000 Americans face what the agency considers unacceptable long-term risks from breathing toxic air as a result of ethylene oxide. Ethylene oxide remains an important option for sterilization due to its chemical compatibility with many different materials and ability to treat devices that are heat- or moisture-sensitive. Some alternative methods for sterilization exist but are not appropriate for all products. It is important to consider well-operated facilities that have reduced emissions and explored less toxic yet effective methods for off-site treatment to reduce harm to communities hosting these facilities. It is also important to consider sterilization requirements by the manufacturer and when possible select medical devices that do not require ethylene oxide for sterilization. A device's ability to be sterilized with alternative methods should be considered as part of procurement criteria.

Key considerations

- Achieving appropriate levels of disinfection (low, medium, high) should be described in the standard operating procedures for each surface and instrument.
- An assessment should be conducted to determine the level of cleaning or disinfection required. It is important to use the appropriate level of sterilization or disinfection depending on the situation. For some surfaces, disinfection may not be necessary.
- Levels of appropriate disinfection and sterilization can be achieved without using the most toxic products. The least toxic yet effective products should be chosen.
- Surfaces must be clean before being sterilized or disinfected. Cleaning with water and soap (or a neutral detergent) helps remove dirt, debris, organic matter, and pathogens or significantly reduce their load on contaminated surfaces.
- The amount of time a sterilant or disinfectant must be left on a surface in order to be effective (dwell time) is important to consider.
- For more, see this resource, or guidelines for disinfection and sterilization in health care facilities or the PAHO Spanish-language manual de esterilización para centros de salud.
- Sterilants and disinfectants must be handled carefully, and their associated wastes must be managed properly to avoid causing harm during disposal. Items must be labeled and staff must be appropriately trained in safe handling and disposal of sterilants and disinfectants.
- It is important to inform employees of the health hazards of sterilants and disinfectants; provide training on safe handling in accordance with labels; furnish appropriate PPE and promote their use; improve risk communication; and encourage employees to report and seek treatment for any illness/injury arising from exposure.
- Reusable medical devices and single-use reprocessable devices can help health care providers diagnose and treat multiple patients while reducing waste, saving resources, and reducing climate impacts. Examples include patient positioning devices, surgical forceps, endoscopes, and stethoscopes.
- Items that can withstand moist heat should be autoclaved. Autoclaves have the advantage of producing rapid temperature rise and short sterilization times with no residual toxic waste. Whenever possible, purchases should prioritize autoclavable items.

- Do not use a combined (one-step) detergent-disinfectant when performing environmental cleaning for C. difficile or spills of blood or bodily fluids. Instead use a two-step process.
- Many complex devices, such as endoscopes, cannot be autoclaved, so chemical disinfectants must be employed. This equipment must first be thoroughly cleaned with soap and water and some form of mechanical action (brushing or scrubbing) to remove organic matter prior to disinfection. Limitations may be imposed by device manufacturers on chemicals that can be used. Seek to procure devices that can be autoclaved or require least toxic disinfectants.
- Effective manual instrument disinfection requires complete contact of all surfaces to the disinfectant.
- The proper processing method depends on the instrument's intended use and the construction of the device, as each material will have different chemical resistance. **Refer to the manufacturer for information about whether alternative disinfectants and sterilants are compatible with the device or surface.**

Hazard summary and alternatives chart

Sterilants and disinfectants

The following chart includes common sterilants and disinfectants used for medical devices and surface disinfection, including hazard summary and a discussion of alternatives. **This chart represents a summary of highlights and is not intended as a comprehensive guide. For more information, consult authoritative and up-to-date resources**. For a more detailed overview of reprocessing chemicals, see the World Health Organization's decontamination and reprocessing of medical devices for health care facilities (2016). Sterilization and disinfection chemicals are categorized by their potency and achieve different aims. See this list of FDA-cleared sterilants and high-level disinfectants.

Hazard summary for some common sterilants and disinfectants

Glutaraldehyde (GA)

Use: GA is a high-level disinfectant; a cold sterilant used to disinfect and clean heat-sensitive medical, surgical, and dental equipment; and a surface disinfectant.

Hazard: Glutaraldehyde is a potent occupational skin irritant and sensitizer and may cause allergy or asthma symptoms or breathing difficulties if inhaled. In addition to occupational asthma, it is associated with increased prevalence of itchy eyes, lacrimation (tearing), and rhinitis. It is a contact allergen and sensitizer and a potent occupational skin irritant (hand and face dermatitis). Studies demonstrate that adverse respiratory health effects may occur even at levels below the current NIOSH recommended exposure limit. When released into the environment, GA is acutely eco-toxic to aquatic organisms. Glutaraldehyde is associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in health care facilities. It is not recommended for disinfection of environmental surfaces and noncritical patient care equipment. GA is classified as a category A hazard.

Ethylene oxide (EtO)

Use: EtO is a chemical sterilant for items that cannot be effectively or safely sterilized by heat or steam, such as rubber goods, oxygen tents, catheters, and telescopic instruments.

Hazard: Ethylene oxide is carcinogenic, mutagenic, irritating, and has a misleadingly pleasant aroma. Ethylene oxide is listed as a human carcinogen because it causes leukemia, cancer of the pancreas, Hodgkin's disease, and stomach cancer (IARC group 1). The effects of exposure to ethylene oxide become more severe as the exposure level increases. EtO may harm an unborn child or cause a miscarriage. It may cause reproductive effects in men and women based on animal studies including reduced fertility. It may cause genetic damage. Long-term exposure can cause brain and nervous system problems and cataracts. Skin contact with ethylene oxide can cause dermatitis, blisters, and burns. EtO is flammable and explosive, as well as a toxic air contaminant. Ethylene oxide is widely used by health care institutions as a sterilant because of its potency in destroying pathogens. EtO is often used with chlorofluorocarbons, primarily to improve safety, that, according to EPA are class I ozone-depleting substances. EtO may be necessary for some uses and should be used in carefully controlled environments.

Quaternary ammonium compounds (including alkyl dimethyl benzyl ammonium chloride, alkyl dimethyl ethylbenzyl ammonium chloride)
Use: QACs are used for surface and instrument disinfection as a low-level disinfectant.

Hazard: QACs are a large group of chemicals that exhibit a range of toxic endpoints. Some are respiratory sensitizers that can cause contact dermatitis and cause or exacerbate asthma. Quaternary ammonium compounds are associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in health care facilities and are very toxic to aquatic life. QACs have higher persistence in the environment compared to other biocides and can contribute to resistance or cross-resistance development more than other biocides. Quaternary ammonium compounds that are not readily biodegradable according to current OECD guidelines, or by any other equivalent test method, should be replaced with safer alternatives per the European Union biocides product regulation. QACs have a more narrow microbicidal spectrum. They are not mycobactericidal or sporicidal and have limited activity against non-enveloped viruses. Diluted solutions can support growth of microorganisms, particularly gram-negative organisms. Antimicrobial activity can be reduced by various materials (cotton, water hardness, microfiber cloths, organic material). These are not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Formaldehyde (formalin and formaldehyde-releasing agents)
Use: These compounds are used as a disinfectant and sterilant for surfaces.

Hazard: The International Agency for Research on Cancer classified formaldehyde as carcinogenic to humans. Exposure to formaldehyde has also been found to cause breathing problems, nasal and eye irritation, neurological effects, and increased risk of asthma. Formalin has been excluded from the list of disinfectants in North America since 1996. Formaldehyde is classified as a category A hazard.

Chlorine-releasing agents including sodium hypochlorite, chlorine bleach, calcium hypochlorite, and N-chloro compounds such as sodium dichloroisocyanurate
Use: These compounds are used for broad-spectrum surface disinfection and in some countries in open containers for instruments.

Hazard: Sodium hypochlorite in open containers can liberate chlorine gas, a respiratory irritant and sensitizer. Sodium hypochlorite can severely irritate and burn the skin and eyes with possible eye damage. It can irritate the nose, throat, and lungs. High exposure can cause a buildup of fluid in the lungs. It can also cause headache, dizziness, nausea, and vomiting. The compounds can be inactivated by organic material. It can release toxic chlorine if mixed with acids or ammonia. Bleach is associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in health care facilities and is classified as a category B hazard.

Biguanides (chlorhexidine, poly (hexamethylene biguanide) hydrochloride PHMB)
Use: These are intended as an antiseptic, disinfectant, and preservative. PMHB is used for cleaning and disinfection of floors, walls, equipment, and fixed surfaces. PHMB is a surface disinfectant and biocide but is not recommended for surface disinfection.

Hazard: PHMB is classified as a category A hazard. PHMB can cause skin irritation, serious eye damage, and damage to organs through prolonged or repeated exposure. A rash or irritation can develop on skin that came into contact with chlorhexidine. Symptoms can include difficulty breathing or severe rash. PHMB is suspected of causing cancer. It is fatal if inhaled and harmful if swallowed. It causes damage to organs through prolonged or repeated exposure by inhalation. It is very toxic to aquatic life with long lasting effects. It is not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Amines N-C12-14-alkyltrimethylenedi (CAS 90640-43-0)
Use: It is intended as a disinfectant.

Hazard: Amines are classified as a category A hazard and causes damage to organs through prolonged or repeated use.It is toxic if swallowed, causes severe skin burns and eye damage, damages organs through prolonged or repeated exposure, and is very toxic to aquatic life with long lasting effects.

Phenolics (carbolic acid)
Use: It is a disinfectant and non-critical instrument cleaner.

Hazard: Phenolics are one of the oldest disinfectant agents. Exposure to phenol may cause irritation to the skin, eyes, nose, throat, and nervous system. Some symptoms of exposure to phenol are weight loss, weakness, exhaustion, muscle aches, and pain. Severe exposure can cause liver and/or kidney damage, skin burns, tremor, convulsions, and twitching. Workers may be harmed from exposure to phenol. The level of harm depends upon the dose, duration, and work being done. It is not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Alternatives summary

Sterilization and disinfection chemicals are categorized by their potency and achieve different aims. The alternative chemicals noted below are not all appropriate for the same level of sterilization or disinfection. For more, consult authoritative sources and vendor information. Workplace controls are critical when using these alternatives including the application of chemicals in closed systems, adequate ventilation and PPE to reduce exposure.

Alcohols (ethyl alcohol and isopropyl alcohol)
Use: Alcohols can be used for disinfection but are not recommended for medical and surgical devices. They have broad spectrum antimicrobial activity but not sporicidal activity. Rapid evaporation makes contact time compliance difficult (on large environmental surfaces). Alcohols can be inactivated by organic material and have low toxicity.

Chlorine dioxide
Use: Chlorine dioxide can be used for high-level disinfection and has a broad spectrum of antimicrobial activity. Chlorine dioxide can irritate the skin and eyes; breathing chlorine dioxide can irritate the nose and throat causing coughing and wheezing; breathing chlorine dioxide can irritate the lungs. Workplace controls are critical when using these alternatives including the application of chemicals in closed systems, adequate ventilation and PPE to reduce exposure.

Hydrogen peroxide (including low-temperature hydrogen peroxide gas plasma and vapor-phase hydrogen peroxide
Use: Hydrogen peroxide is an oxidizing agent used for high-level disinfection and sterilization and has a broad spectrum of antimicrobial activity. HP is active in the presence of organic material. Under normal conditions, hydrogen peroxide is extremely stable when properly stored (in dark containers). Hydrogen peroxide and peroxygen compounds have low toxicity but can cause irritation to the eyes, nose, skin, and throat depending upon the dose, duration, and work being done. Peracetic acid and products that combine peracetic acid and hydrogen peroxide carry a risk of acute toxicity via inhalation and pose a hazard to the aquatic environment. Workplace controls are critical when using these alternatives including the application of chemicals in closed systems, adequate ventilation and PPE to reduce exposure.

Ortho-phthaladeyde (OPA)
Use: OPA is intended for high-level disinfection and sterilization. OPA has caused respiratory sensitization in mice.

It has been linked to bronchial asthma and contact dermatitis in health care workers. It is recommended that it be used with a fully automated washing machine with a local air exhauster. OPA is recommended for substitution where possible and is not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Ozone gas

Use: Ozone gas is intended as a sterilant and disinfectant and used for rigid medical devices. Sometimes in combination with hydrogen peroxide, ozone is a toxic gas and respiratory system irritant. It is a priority pollutant contributing to the formation of smog. Plastics and rubber are incompatible with ozone sterilization. It is not intended for use with any flexible endoscopes, glass or plastic ampoules, liquids or implants, or latex and textile fabrics.

Iodophors including povidone-iodine

Use: Iodophors are intended as antiseptics on skin or tissue and should not be used alone as a sterilant or high-level disinfectant. They are used for disinfecting blood culture bottles and medical equipment but are not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Peracetic acid

Use: Peracetic acid is intended as a sterilant and disinfectant and is an oxidizing agent that acts similarly to hydrogen peroxide. It has a broad spectrum of antimicrobial activity and does not produce toxic waste. Peracetic acid and products that combine peracetic acid and hydrogen peroxide carry a risk of acute toxicity via inhalation and asthma and pose a hazard to the aquatic environment. Workplace controls are critical when using these alternatives including the application of chemicals in closed systems, adequate ventilation, and PPE to reduce exposure. It is not recommended for disinfection of environmental surfaces and noncritical patient care equipment.

Peracetic acid/hydrogen peroxide

Use: This combination is used for high-level disinfection, has a broad spectrum of antimicrobial activity, and does not produce toxic waste. These compounds can have irritant properties particularly in combination, have been associated with toxicity via inhalation and asthma, and pose a hazard to the aquatic environment. Workplace controls are critical when using these alternatives including the application of chemicals in closed systems, adequate ventilation, and personal protective equipment to reduce exposure.

Other methods of sterilization and disinfection

- Steam sterilization
- Flash sterilization
- UV radiation
- Ionizing radiation
- Microwave
- Steam sterilization with added chemicals
- Plasma

The Viennese database for disinfectants compares the toxicological profiles of disinfection products. The database assumes proper handling and disposal of disinfectants, including adequate PPE use. **The mixing of ingredients and their effects are not taken into account, nor are substance concentrations**.

For a full list of FDA-cleared sterilants or high-level disinfectants see this list (2019).

For a more detailed comparison of high-level disinfectants see WHO's decontamination and reprocessing of medical devices for health care facilities (2016).

Tools and resources: Alternatives

Database | The Viennese database for disinfectants (WIDES database) enables purchasers and users of disinfectants to compare the toxicological profiles of products for the disinfection of hands, skin, surface, laundry, and instruments. Here is an overview of assessed ingredients.

Report | HCWH Promoting safer disinfectants in the health care sector SAICM 2.0 final report (2020)

Website | HCWH Sustainable procurement resources

Tools and resources

Fact sheet | HCWH Sustainable procurement quick guide: Safer manual instrument disinfection (2020)

Fact sheet | HCWH Sustainable procurement quick guide: Safer surface disinfection (2020)

Fact Sheet | HCWH Sustainable procurement quick guide: Routine hand hygiene (2020)

Fact Sheet | EPA Ethylene oxide (2018)

Fact Sheet | PGH Sterilization and high-level disinfection options: Sample of pros and cons (2008)

Fact Sheet | HCWH 10 reasons to eliminate glutaraldehyde

Guidance | FDA-cleared sterilants and high-level disinfectants with general claims for processing reusable medical and dental devices (2019)

Guidance | Pan American Health Organization Sterilization manual for health centers (2009)

Guidance | WHO and PAHO Decontamination and reprocessing of medical devices for health care facilities (2016) See p. 71 for a chart of the pros and cons of sterilants and disinfectants.

Guidance | Salud sin Daño Guide for the substitution of dangerous chemicals in health care (available in Spanish) (2015)

Journal article | AJIC Cleaning and disinfecting environmental surfaces in health care: Towards an integrated framework for infection and occupational illness prevention (2015)

Report | HCWH Promoting safer disinfectants in the health care sector SAICM 2.0 final report (2020)

Report | CDC and ICAN Best practices for environmental cleaning in health care facilities in resource-limited settings (2019)

Report | WHO Implementation manual to prevent and control the spread of carbapenem-resistant organisms at the national and health care facility level: Interim practical manual supporting implementation of the guidelines for the prevention and control of carbapenem-resistant enterobacteriaceae, acinetobacter baumannii, and pseudomonas aeruginosa in health care facilities (2019)

Report | ESGE and ESGENA Reprocessing of flexible endoscopes and endoscopic accessories used in gastrointestinal endoscopy: Position statement of the European Society of Gastrointestinal Endoscopy and European Society of Gastroenterology Nurses and Associates (2018)

Report | Instituto Nacional de Seguridad e Higiene en el Trabajo-Ministerio de Trabajo y Asuntos Sociales NTP 429: Desinfectantes: Características y usos más corrientes (available in Spanish)

Report | Instituto Nacional de Seguridad e Higiene en el Trabajo-Ministerio de Trabajo y Asuntos Sociales NTP 506: Prevención de la exposición a glutaraldehído en hospitales (available in Spanish)

Report | WHO Essential environmental health standards in health care provides guidance on essential environmental health standards required for health care in medium- and low-resource countries and supports the development and implementation of national policies. (2008)

Toolkit | CDC Infection prevention and control assessment tool for acute care hospitals (2016)

Website | Guideline for Disinfection and Sterilization in Healthcare Facilities (Update: May 2019)

Website | Practice Greenhealth Sterilants and disinfectants website

Website | HCWH Europe Promoting safer disinfectants in the health care sector

Website | Healthcare Environmental Resource Center Sterilants and disinfectants in health care facilities, pollution prevention, and compliance assistance for the health care industry

Case studies

Philippines: Acetic acid: A safer alternative as surface disinfectant (2019)

Colombia: Estrategias para el reemplazo de sustancias químicas nocivas por alternativas más seguras: inventarios, planes de reemplazo y programas de manejo seguro (2017)

Colombia: Chemical substitution case studies (p. 32) (2020)

United States: Rigid endoscopes: Reducing need for hazardous sterilizers (2009)

United States: Woodland Hills Medical Center eliminates glutaraldehyde (p. 2) (2002)

United States: U.S. EPA fact sheet on EtO and glutaraldehyde with case studies (2002)

Safer cleaners

Rationale

Cleaning is the foundation of infection prevention in health care, but some common cleaners used in the health care setting can pose hazards to employees and the environment. Health care facilities throughout the world have successfully implemented safer cleaning programs while maintaining the effectiveness of their infection prevention and control efforts.

Some cleaning products contain chemicals known to cause cancer, asthma, reproductive organ damage, birth defects, kidney damage, neurological impacts, and other serious health effects. Cleaners have also been linked to occupational asthma and respiratory diseases in health care workers. Janitorial workers experience very high rates of occupational asthma, among the highest of any occupation. Cleaning chemicals can contain high levels of volatile organic compounds (VOC), which can cause respiratory irritation, headaches, and other symptoms in workers and building occupants. Exposure to and contact with chemicals used for cleaning may also cause irritation of eyes, nose and throat; skin rashes, dizziness, headaches, nausea and chemical sensitivity. Some cleaning formulations also contain hazardous sterilants and disinfectants including quaternary ammonium compounds, glutaraldehyde, and bleach, which are associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in healthcare facilities. Safer cleaners have been demonstrated to reduce adverse health symptoms.

Patients in the health care setting are particularly vulnerable to hazards that can degrade the quality of indoor air, since many have compromised respiratory, neurological, or immune systems for example, and/or higher sensitivity to chemicals. Health care workers are also uniquely vulnerable as a result of repeated occupational exposures. In some instances, there has been an increase in the number of respiratory ailments reported among health care workers.

Many chemicals of concern in cleaning compounds have also been documented to have adverse effects on the environment and ecosystems. Cleaning practices can contribute to air pollution, water pollution, and climate change. Some ingredients in cleaning products are associated with eutrophication of streams and toxicity to aquatic organisms. Volatile organic compounds released from cleaning products contribute to smog formation, and VOC content is regulated in some jurisdictions for this reason. Other ingredients such as alkylphenol ethoxylate surfactants persist in the environment and may interfere with the hormonal system of exposed organisms, which can threaten ecosystems.

Key considerations

- Health care organizations should conduct an infection control risk assessment in collaboration with their infection prevention and control committee to determine which areas within the hospital require routine cleaning and which require both cleaning and disinfection.
- Noncritical care areas such as offices, waiting areas, hallways, and the cafeteria should be cleaned with general cleaners and need little disinfection. Noncritical care areas account for between 45% to 65% of the average facility.
- When surfaces or instruments have dirt or organic matter on them, it is necessary to clean with soap and water prior to disinfection for the disinfectant to be effective.
- Best practices for assessing and implementing a green cleaning program include:
  - Inventory all of the cleaning products currently in use at your facility.

        - Properly identify noncritical and critical areas and assure proper levels of disinfection while eliminating unnecessary disinfection.
    - Start with sustainable cleaners for general uses including windows, floors, bathrooms, glass, carpet, upholstery, odor removal, degreasing, and laundry.
    - Use microfiber mops for cleaning.
    - Use automated dispensers for cleaning chemicals.
    - Eliminate the use of open chlorine buckets.
    - Use least toxic specialty cleaners and only when needed.
    - Use only fragrance-free products in your facility.
    - Investigate non-chemical alternatives like UV light and high filtration vacuums.
- Additional considerations for safety include assuring:
    - Cleaning products are stored safely.
    - Areas are ventilated properly during storage and use.
    - Splashes and spills are prevented through proper design and handling.
    - Skin contact with cleaning chemicals is eliminated.
    - Exposure to mists, vapors, and/or gases is eliminated.
- Workers should be informed of health and physical hazards of the cleaning chemicals; proper handling, use, and storage including dilution procedures; and spill procedures including proper use of PPE.
- Hazard and use information should be readily available for all workers, including an explanation of how to read labels.
- Safety data sheets should be provided for all employees.
- Many current cleaning practices are based on perceived rather than actual risks. Many hospitals respond to high infection rates by using disinfectants in almost every area and on almost every surface.
- Microorganisms are a normal contaminant of walls, floors, and other housekeeping surfaces and are rarely associated with direct transmission of infection to patients or personnel.
- Expectations about cleaning (shiny floors, strong fragrances) do not necessarily have anything to do with actual cleanliness or low rates of infection.
- Cleaning formulations containing quaternary ammonium compounds, glutaraldehyde, and bleach are associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in health care facilities.
- Never mix different cleaning chemicals together. Dangerous gases can be released.

Green cleaning hazard summary and alternatives chart

Hazard summary	Alternatives summary
Traditional cleaners may include a variety of hazardous chemicals including surfactants, fragrances, disinfectants, solvents, metals, and other compounds. • Some cleaning products can enter the body through skin contact or from breathing gases into the lungs. • Solvents like glycol ethers in cleaning products can pose threats to pregnant women. • Volatile organic compounds in cleaning chemicals can give rise to respiratory irritation, headaches, and other symptoms in workers and building occupants • Some chemicals in cleaning products can cause or exacerbate asthma.	A good place to start with alternative cleaners is to substitute carpet, window, all purpose, bathroom, laundry, and general floor care cleaners where there are more sustainable options. **Ecolabel index** is the largest global directory of ecolabels. It is currently tracking 447 ecolabels in 197 countries and 25 industry sectors. Blue Angel cleaning chemicals list Nordic Swan cleaning chemicals list

• Cleaning products can contain disinfectants like quaternary ammonium compounds, glutaraldehyde, and bleach that have associated hazards (see sterilants and disinfectants). • Cleaning products that contain corrosive chemicals can cause severe burns if splashed on the skin or in the eyes. • Mists, vapors, and/or gases from cleaning chemicals can irritate the eyes, nose, throat, and lungs. • Some fragrances in cleaning products have been linked to eye and skin irritation, headaches, breathing problems, and other health impacts. • Mixing cleaning products that contain bleach and ammonia can cause severe lung damage or death. • Surfactants such as alkylphenol ethoxylates degrade into nonylphenol, which is toxic to aquatic wildlife.	Use Green Seal's standard for cleaning products for industrial and institutional use (GS-37) to find certified greener cleaning products. Use UL's standard for sustainability for carpet and upholstery care products (UL 2795) to find certified greener cleaning products. Use UL's standard for sustainability for hard surface cleaners (UL 2759) to find certified products that comply with this goal. Non-chemical alternatives include high-filtration vacuum cleaners and UV light disinfection rather than chemicals in select areas.

Tools and resources: Alternatives

Certification | Ecolabel index is the largest global directory of ecolabels. It is currently tracking 447 ecolabels in 197 countries and 25 industry sectors. For the health care industry, the standard would be GS-42.

Certification | Germany Blue Angel cleaning chemicals list

Certification |Nordic Swan cleaning chemicals list

Certification | National Agency for Public Procurement in Sweden criteria for sustainable cleaning products

Certification | Green Seal standard for commercial and institutional cleaning services (GS-42) establishes environmental requirements for cleaning service providers of commercial, public, and institutional buildings.

Certification | Green Seal standard for cleaning products for industrial and institutional use (GS-37) locates certified greener cleaning products and covers industrial and institutional specialty surface cleaning products (GS-53).

Certification |UL's standard for sustainability for cleaning chemicals and carpet and upholstery care products (UL 2795) helps find certified greener cleaning products.

Certification | U.S. EPA safer choice program includes certified cleaning products.

Database | The Viennese database for disinfectants (WIDES database) enables purchasers and users of disinfectants to compare the toxicological profiles of products for the disinfection of hands, skin, surface, laundry, and instruments. See overview of assessed ingredients.

Report | CDC and ICAN Best practices for environmental cleaning in health care facilities in resource limited settings in resource-limited settings.

Website | City of San Francisco, SFtool.gov. Cleaning chemical Guidance and lists, including contract language

Tools and resources

Fact Sheet | NIOSH, OSHA Protección de los trabajadores que utilizan productos químicos de limpieza (available in Spanish) (2012)

Fact Sheet | NIOSH, OSHA Protecting workers using cleaning chemicals (2012)

Guidance | Stockholm County Council Phase-out list for chemicals hazardous to the environment and human health in products (2017)

Guidance | HCWH Guidance to achieve safer chemicals challenge for green cleaning (2016)

Guidance | U.S. EPA, RPN Green cleaning P2 calculator quantifies projected environmental benefits of purchasing and using sustainable janitorial services and products and identifies which measures will have the greatest impact.

Guidance | California Department of Public Health Healthy cleaning and asthma-safer schools: A how-to guide (2014)

Guidance | Hospitals for a Healthy Environment Ten-step guide to green cleaning implementation (2006)

Guidance | U.S. EPA Introduction to eco-labels and standards

Infographic | HCWH Non-toxic health care: Reducing risks with safer alternatives

Journal article | AJIC Cleaning and disinfecting environmental surfaces in health care: Towards an integrated framework for infection and occupational illness prevention (2015)

Report | HCWH: Promoting safer disinfectants in the health care sector SAICM 2.0 final report (2020)

Report | CDC and ICAN Best practices for environmental cleaning in health care facilities in resource limited settings in resource-limited settings (2019)

Report | HCWH Cleaning in health care facilities: Reducing human health effects and environmental impacts (2009)

Website | Practice Greenhealth green cleaning webpage

Case studies

Denmark: Cleaning services at Randers Regional Hospital certified with the Nordic Swan ecolabel (2020)

Australia: An environmental cleaning bundle and health care-associated infections in hospitals (2019)

Ecuador: Efficacy of pulsed-xenon ultraviolet light for disinfection of high-touch surfaces in an Ecuadorian hospital (2019)

United States: Green cleaning in health care: Current practices and questions for future research (2011)

Hand hygiene and gloves

Rationale

Hand hygiene is universally recognized as the most critical first line of defense against infectious diseases, and a central infection prevention strategy in health care. A variety of products are used for hand hygiene, including liquid soap, bar soap, foam soap, hand sanitizer, hand rub, and lotion. Substances used in hand hygiene products include regular soap and water, or antimicrobials, for antiseptic formulations. However, some common ingredients in hand hygiene products used in the health care setting can pose hazards for employees and the environment. Health care workers can wash or sanitize their hands in a single shift as many as 100 times, according to the CDC, leading to measurable exposures. Triclosan, triclocarban, chlorhexidine gluconate, polyhexamethylene biguanide, and silver have come under increased scrutiny due to health and environmental concerns. Some of these ingredients have sensitising properties and are carcinogenic, mutagenic, repro-toxic and/or associated with chronic toxicity or toxic to aquatic organisms. Hand hygiene products that contain hazards should be replaced with products that offer a safe and effective alternative.

Gloves are also a critical component of infection prevention and are discussed in the next section.

Alternatives

Alcohol-containing disinfectants are recommended for routine hand hygiene in most clinical situations where disinfection is required based on efficacy, tolerability, and cost-effectiveness.

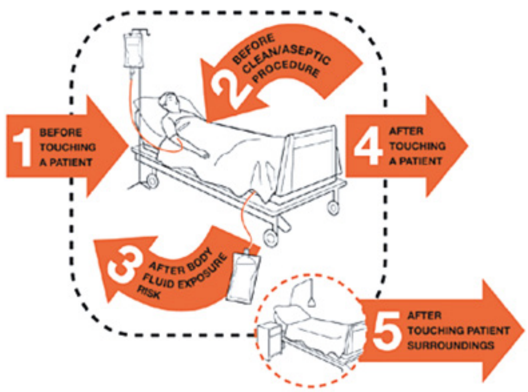
WHO gives instructions for preparing two effective alcohol-based handrub (ABHR) formulations for in-house/local production when suitable commercial products are either unavailable or too costly. According to current evidence, the formulations are effective against coronaviruses. The CDC also recommends using ABHR with 60 to 95% alcohol in health care settings.

The WIDES database can help procurers choose the most suitable product by comparing the hazard profiles of frequently used hand hygiene products.

See the hazard summary and alternatives chart below for more details.

Key considerations

- Hand hygiene is regarded as the single most important action to prevent HAIs, yet compliance is low. On average, 61% of health workers do not adhere to recommended hand hygiene practices.
- Hand hygiene includes cleaning hands at the right time and in the right way. WHO has developed the SAVE LIVES: Clean Your Hands campaign that outlines the five key moments for hand hygiene.



Source: World Health Organization. Hand Hygiene: Why, How & When? (2009)

- Hands should be washed with soap and water for at least 20 seconds when visibly soiled, before eating, after removing gloves, and after using the restroom.
- When hands have dirt or organic matter on them, it is necessary to clean with soap and water prior to disinfection for the disinfectant to be effective.
- Unless hands are visibly soiled, an alcohol-based hand rub is preferred over soap and water in most clinical situations due to evidence of better compliance compared to soap and water.
- When simple soap and water is sufficient, choose soap without disinfectants and fragrance.
- It is important to combine correct hand hygiene with skin care. Dry, cracked hands can pose a hazard. It may be helpful to have more than one hand rub available to accommodate different skin reactions.
- Hand rubs are generally less irritating to hands and effective in the absence of a sink.
- Wear gloves only when recommended. The use of gloves does not replace the need for hand hygiene by either hand rubbing or washing. See the gloves section below.

Hazard summary and alternatives chart

Hazard summary and alternatives chart
Triclosan in hand soaps, washes, wipes, and gels can increase the risk of more generalized antibiotic resistance and have adverse health effects. Widespread exposure to triclosan is well documented in the general human population. Studies show a growing number of potentially adverse impacts in laboratory animals and wildlife including effects on the thyroid, estrogen, and testosterone systems. Triclosan exposure has also been associated with increased risk of hay fever, allergies, and asthma in humans. Use of triclosan-containing toothpaste or hand soaps significantly increases urinary triclosan levels. Some triclosan discharged to wastewater can be released to surface water and sludge. Triclosan can persist in the environment and contaminate fish and even food grown in sludge-amended soil. Some studies, but not all, show that bacteria resistant to triclosan can also become resistant to other antibiotics. The 2014 Society for Healthcare Epidemiology of America compendium on hand hygiene advises against the use of triclosan-containing soap in health care facilities because of lack of evidence of superior clinical effectiveness compared to other products, concern about promoting antibiotic resistance, widespread human exposures, and potential adverse health effects. The **European Union restricts the level of triclosan** in some products, including hand soaps. In 2018, the U.S. Food and Drug Administration restricted the use of triclosan, triclocarban, chlorhexidine gluconate, iodophors, phenol, methylbenzethonium chloride, and 15 other ingredients in antiseptic washes and rubs used in health care. They also concluded that triclosan's efficacy may be decreasing.

Triclocarban is a chlorinated organic compound in widespread use. Triclocarban is environmentally persistent, detectable in many rivers and streams, and tends to bioaccumulate in many invertebrates. Triclocarban shares a number of toxic properties with triclosan, including hormonal effects. The Florence statement on triclosan and triclocarban concludes that triclosan and triclocarban do not provide health benefits and can cause health and environmental harm.

Chlorhexidine gluconate has been linked to skin irritation and serious eye damage. It is very toxic to aquatic life and may cause cross-resistance to antibiotics. Eye and face protection are recommended as well as washing after handling. A systematic literature review of the use of chlorhexidine gluconate in hand hygiene found "no significant difference in HAI rates when using CHG for hand hygiene," and "the use of CHG was associated with skin reaction events." The study further found "strong evidence regarding the risks and benefits of CHG for hand hygiene is still lacking… it is advisable to reserve the use of CHG for purposes other than hand hygiene." In 2018, the U.S. Food and Drug Administration restricted the use of chlorhexidine gluconate. This product may be required for surgical scrub products when alternatives are not appropriate.

Polyhexamethylene biguanide (PHMB) is widely used as a fungicide, algicide, and sanitizer in swimming pools; a preservative for cut flowers; a materials preservative; a bacteriostat in industrial processes and water systems; and a hard surface disinfectant, as well as a hand hygiene ingredient. Based on a 2019 review of the use of PHMB for hand hygiene by the European Union, PHMB is considered toxic to the environment and very persistent and is therefore a candidate for substitution. There is no evidence of endocrine effects of PHMB. The substance cannot be considered as carcinogenic, mutagenic or toxic for reproduction. This product may be required for surgical scrub products when alternatives are not as efficacious.

Quaternary ammonium compounds (QACs) are a large group of chemicals that exhibit a range of toxic endpoints. QACs are often combined or added to disinfectant formulations. Some QACs are respiratory sensitizers that can cause contact dermatitis and cause or exacerbate asthma. QACs can irritate the skin and cause rashes if not used in accordance with instructions. Some QACs can cause allergic skin rashes even with very limited exposure. Eye contact with QACs can cause burning of the eyes, and inhaling QACs can cause irritation of the nose and throat. Two commonly used QACs can trigger asthma symptoms or cause asthma. The long-term health effects of QACs have not been fully studied. QACs are associated with some of the highest reports of acute antimicrobial pesticide-related illnesses among workers in health care facilities. QACs have higher persistence in the environment when compared to other biocides and can contribute to resistance or cross-resistance more than other biocides. QACs may be required in circumstances where alternatives are not appropriate.

Metals

Silver in hand soaps, washes, wipes, and gels has not shown to be effective in reducing HAIs and is an acute aquatic toxicant. The use of silver hand hygiene products may contribute to antimicrobial resistance. Evidence of acquired silver resistance is to gram-negative and not gram-positive bacteria. Silver preparations in soap are not recommended by the CDC for hand hygiene in hospitals. Silver in various forms including nanosilver particles may be released to the environment during product manufacture, use, and disposal or to wastewater treatment plants. Silver is sequestered in sewage sludge. Land application of sewage sludge enables more general environmental releases, including into surface waters. Human health risks associated with metallic or ionic silver exposure through the skin, gastrointestinal tract, or lungs are relatively low, but silver is highly toxic to many aquatic organisms. A European Union review categorized silver nanoparticles and salts as extremely toxic or very toxic to crustaceans, algae, and fish. Sweden is proposing a mandatory classification and labelling at the EU level for silver as a skin sensitizer, suspected mutagen, presumed reprotoxicant, and toxicity to aquatic organisms. A recent EU SCCS scientific review identified certain aspects of nanomaterials that constitute a basis for concern over safety to consumers' health when used in cosmetic products. Silver toxicity may be reduced when it forms complexes with other molecules or materials in the environment.

Mercury is a potent neurotoxicant for humans and wildlife. Mercury should not be used in hand hygiene formulations. For more information, see the mercury chapter.

Fragrances and colorants are added to many products to mask unwanted odors or improve a product's fragrance or appearance. The proportion of people with respiratory hypersensitivity to strong scents is increasing. Fragrances and colorants can also contain hazardous substances, such as phthalates. Because fragrance and colorant compounds are not critical to the function of most products and can lead to allergies or allergic reactions, they should be avoided. It is usually possible to manufacture products from raw materials of high quality that do not have an odor.

Microplastics and microbeads have been added to a wide range of products like hand soaps and body scrubs. Microbeads found in personal care products are typically smaller than 1 mm. Microbeads have largely replaced traditional, biodegradable alternatives such as ground nut shells and salt crystals. Microbeads in hand soaps, washes, and gels do not serve a clinical function. The microbeads used in personal care products are primarily made of polyethylene but can also be made of polypropylene, polyethylene terephthalate, polymethyl methacrylate, and nylon. Microbeads are generally too small to be captured by standard filters used at sewage treatment plants and therefore enter the environment. When products containing microbeads are used, they flow through sewer systems and end up in rivers, canals, lakes, seas, and oceans. Microbeads are also entering the food chain.

Microplastics are a broader category defined as plastic pieces or fibers measuring less than 5 mm. The spread of microplastics regionally and throughout the marine environment is well documented, and the amount of microplastics is rapidly accumulating. In a recent study, microplastics were detected for the first time in human placentas in maternal, fetal, and amniochorial membranes. The EU is currently preparing a microplastics restriction for intentionally added microplastics. Microbeads will not always be listed on product labels even though a product may contain them. Instead a product label might list: polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polymethyl methacrylate (PMMA) and nylon.

Alternatives summary

For most clinical uses, soap and water and alcohol-containing disinfectants are recommended for routine hand disinfection in most clinical situations where disinfection is required because of alcohol's efficacy, tolerability, and cost-effectiveness. Surgical applications may require additional disinfection.

WHO gives instructions for preparing two effective alcohol-based handrub formulations for in-house/local production when suitable commercial products are either unavailable or too costly. According to current evidence, the formulations are effective against coronaviruses. The U.S. Centers for Disease Control and Prevention recommends using ABHR with 60 to 95% alcohol in health care settings.

• WIDES database: To find safer hand hygiene products, the WIDES database helps procurers choose the most suitable product by comparing the hazard profiles of frequently used hand hygiene products for specific applications.

Green Seal standard for hand cleaners and hand sanitizers for industrial and institutional use products do not contain triclosan, triclocarban, or other chemicals of concern and would apply to non-clinical areas in medical facilities.

To find certified greener cleaning products see Underwriters Laboratory Standards for non-clinical areas in medical facilities: For Disinfectants and Disinfectant Cleaners use UL 2794, or Instant Hand Antiseptics use UL 2783.

Gloves

Gloves are a critical component of infection prevention and are the **highest-volume disposable product** procured by health care. Glove use has increased dramatically and is expected to nearly double in the next five years.

Some materials used to manufacture gloves can be toxic throughout their life cycle, such as PVC. Every step in the production of PVC involves chemicals of high concern. PVC is derived from vinyl chloride, a known human carcinogen. The manufacture and disposal of gloves can also threaten surrounding communities and workers. Burning PVC gloves can result in the formation of highly toxic chemicals, and recycling PVC is challenging and can hinder the recycling of other kinds of plastic.

Additionally, ortho-phthalate plasticizers are added to PVC and other plastics to impart flexibility. These compounds are used in many products so exposure is widespread and can be cumulative. Adverse effects include hormone disruption, reproductive and developmental impacts, and kidney toxicity. Exposure to some ortho-phthalates is associated with an increased risk of asthma.

Some biocides used in gloves can be dangerous or toxic to humans and the environment and may accelerate the development of resistance to bacteria. Many gloves are made with accelerants like thiurams, thiazoles, and carbamates that are contact allergens and can cause skin irritation and/or sensitization.

It is possible to reduce glove use while maintaining model infection prevention. Gloves are not a substitute for hand hygiene and should be used only where they have been demonstrated to reduce contamination for either the practitioner or the patient. Evidence suggests that gloves can be used inappropriately in clinical practice. Improper use of non-sterile gloves can lead to cross contamination and has been implicated in infection outbreaks. A pilot project in the UK NHS system showed glove use could be dramatically reduced with significant savings while maintaining infection prevention and improving care.

Labor concerns

Recent reports have documented worker exploitation around glove manufacture including forced labor, poor working conditions, and debt bondage. The U.S. Customs and Border Protection agency barred some products from being distributed in the country after finding reasonable evidence that the companies were using forced labor. Allegations of abuse in glove production also include passport confiscations, illegal withholding of pay, and restricted freedom of movement.

As a result, it is important to research glove sourcing and require suppliers to have effective risk management protocols in place regarding workers' rights in accordance with the ILO's core conventions both in their operations and the supply chain of subcontractors.

Key issues to consider:

- According to standard precautions, wear gloves when contact with blood or other potentially infectious materials, mucous membranes, non-intact skin, potentially contaminated skin, or contaminated equipment could occur.
- Gloves are often used when they aren't needed, put on too early, taken off too late, or not changed at critical points.
- Glove use can be dramatically reduced with significant savings while maintaining infection prevention and improving care.
- Sterile and non-sterile gloves each have a distinct purpose:
    - Sterile gloves are used to protect the patient from the practitioner.
    - Non-sterile gloves are used to protect the patient, practitioner, or other user such as when there is direct contact with hazardous chemicals, body fluids, non-intact skin, or where contact with mucous membranes is anticipated.
- Gloves are not a substitute for hand hygiene.
    - If your task requires gloves, perform hand hygiene prior to donning gloves and before touching the patient or the patient environment.
    - Perform hand hygiene immediately after removing gloves.
- Change gloves and perform hand hygiene during patient care if:
    - Gloves become damaged.
    - Gloves become visibly soiled with blood or body fluids following a task.
    - Moving from work on a soiled body site to a clean body site on the same patient or if another clinical indication for hand hygiene occurs.
- Never wear the same pair of gloves in the care of more than one patient. Gloves should be removed

immediately after a procedure to prevent cross contamination. Carefully remove gloves to prevent hand contamination. Hands should then be decontaminated.

- Choose gloves that are appropriate for their intended use. The glove selection and usage guidance provides more information on how to select the right glove for the task. For example, the barrier protection required of biologics, radioactive material, or chemicals must be matched with the appropriate glove material.
- Observe the recommended personal protective equipment (table 5) for environmental cleaning tasks and cleaning in specific patient areas.
- Gloves should not be used for routine duties, such as dispensing solid medication. Practitioners should use the aseptic non–touch technique (ANTT).
- Research shows that patients often feel uncomfortable with the inappropriate use of gloves for personal tasks.
- Half of all health care workers may experience dermatitis in any year. Approximately one in five nurses develops hand dermatitis, a painful, debilitating condition that may require staff to be moved out of clinical areas.
- Allergenic ingredients in gloves can cause type 1 and type 3 hypersensitivity reactions, depending on the agent. It is important to diagnose the allergic reaction correctly to choose the appropriate gloves for the practitioner.
- For latex gloves, closely monitor allergy concerns including information on protein content and the extent of powdered content.
- Some practitioners may be allergic to the accelerants used in many gloves.

Glove comparison

The chart below is a summary of some of the advantages and disadvantages of different glove materials. This is not a comprehensive review.

Glove Material	Advantages and disadvantages Source: Adapted from Joint Commission Environment of Care and OSHA PPE guidance
Butyl (synthetic rubber)	Excellent barrier protection and strength; resistance to ketones, acids, caustics, isocyanate, and gases. Good for ketones and esters. Poor for gasoline and aliphatic, aromatic, and halogenated hydrocarbons.
Latex (natural rubber)	Excellent barrier protection and strength; excellent elasticity; excellent comfort. Used for biological and water-based materials; poor for organic solvents; little chemical protection; hard to detect puncture holes; can cause or trigger latex allergies.
Nitrile	Excellent barrier protection and general use glove; excellent strength; high level of tactile sensitivity for users when conducting tasks; elasticity and fit and comfort are very good; shows clear indication of tears and breaks; good alternative for those with latex allergies; superior resistant to punctures and abrasion; resistant to several chemicals like glutaraldehyde; good for use with solvents, oils, greases, and some acids and bases; oxygen, UV light, and ozone can deteriorate; may contain curing agents.
Neoprene (polychloro-prene)	Excellent barrier protection; excellent strength but tears easily once punctured. Newer products have excellent elasticity and very good fit and comfort. Used for many hazardous chemicals.

Polyethylene	Not suitable for clinical applications. Used for light-duty tasks that require frequent glove changes like food service lines, deli counters, and other high-volume applications.
Polyisoprene	Excellent puncture, tear, and abrasion resistance. Excellent elasticity, good comfort and tactile sensitivity; excellent barrier protection; may also be a suitable glove for chemotherapy; contains accelerators.
Polyurethane	High tensile strength; vulnerable to alcohol breakdown; slippery; embrittles and hardens at low temperatures; resistant to oil and abrasion.
Polyvinyl alcohol	Resistant to snags, punctures, abrasions, and cuts. Not suitable for environments where they may be exposed to water or light alcohols. Very high resistance to aliphatics, aromatics, chlorinated solvents, esters, and most ketones.
Polyvinyl chloride	Poor barrier protection; weakest film for strength and durability; very limited elasticity, fit, and comfort. Used for acids, bases, oils, fats, peroxides, and amines; poor for most organic solvents, glutaraldehyde, and chemotherapy agents; vulnerable to breakdown from alcohol; may rupture more often during use compared to other gloves.

Tools and resources: Alternatives

Hand hygiene

Fact sheet | HCWH Sustainable procurement quick guide: Hand hygiene

Guidance | WHO-recommended handrub formulations (2009)

Guidance | WHO guidelines on hand hygiene in health care (2009)

Guidance | Kaiser Permanente handcare product utilization guidelines (2011)

Database | City of Vienna Climate Protection Programme Viennese database for disinfectants

Certification | Green Seal standard for hand cleaners and hand sanitizers for industrial and institutional use (GS-41)

Certification |UL's standard UL 2794 disinfectants and disinfectant cleaners and standard UL 2783 instant hand antiseptics

Gloves

Fact sheet | HCWH Sustainable procurement quick guide: Gloves

Database | HCWH Europe's safer medical devices database lists alternatives that do not contain PVC, phthalates, and BPA.

Database | U.S. General Services Administration sustainable facilities tool database contains lists of gloves that do not contain PVC, DEHP, other phthalates and latex.

Tools and resources

Hand hygiene

Guidance | WHO Health care without avoidable infections: The critical role of infection prevention and control (2016)

Guidance | WHO Guidelines on hand hygiene in health care: First Global Patient Safety Challenge Clean Care is Safer Care, published by the World Health Organization (2009)

Guidance | CDC Hand hygiene in health care settings

Guidance |CDC Guidance for health care providers about hand hygiene and COVID-19

Guidance | Society for Healthcare Epidemiology of America Expert guidance on hand hygiene in health care settings: Recommendations of the Healthcare Infection Control Practices / Advisory Committee and the HICPAC/ SHEA/APIC/IDSA - Hand Hygiene Task Force, published by the Society for Healthcare Epidemiology of America: Summary (2014)

Guidance | U.S. Food and Drug Administration final rule (2017)

Journal Article | JOEM Health care worker exposures to the antibacterial agent triclosan

Report | HCWH: Promoting safer disinfectants in the health care sector SAICM 2.0 final report (2020)

Report | ECHA Restricting the use of intentionally added microplastic particles to consumer or professional use products of any kind (2019)

Report | Environmental Health Perspectives The Florence statement on triclosan and triclocarban (2017)

Report | Toxics Links Disrupting triclosan: A potential endocrine-disrupting chemical found in toiletries (2016)

Report | EU Scientific Committee on Consumer Safety Opinion on triclosan antimicrobial resistance (2010)

Report | HCWH and FOE Nano and biocidal silver: Extreme germ killers present a growing threat to public health (2009)

Website | WHO Infection prevention and control

Website | Practice Greenhealth Safer hand hygiene

Website | HCWH Sustainable procurement resources

Website | European Chemicals Agency: Triclosan
Website | International campaign against microbeads in cosmetics

Webinar | Practice Greenhealth Safer hand hygiene: The case for eliminating triclosan and triclocarban and lessons from the field (2017)

Gloves

Fact sheet | HCWH Sustainable procurement quick guide: Gloves

Fact sheet |HCWH Sustainable procurement quick guide: Reducing PVC and DEHP in medical products (2020)

Fact sheet | NIOSH alert: Preventing allergic reactions to natural latex rubber in the workplace (1997)

Guidance | NIOSH Latex allergy prevention guide

Report | HCWH Polyvinyl chloride in health care: A rationale for choosing alternatives (2020)

Report | HCWH Europe: Non-toxic health care: Alternatives to hazardous chemicals in medical devices: Phthalates and bisphenol A (Second edition, 2019)

Website | HCWH Europe Sustainable procurement resources

Website | HCWH Latin America Chemical substances resources

Case studies

Hand hygiene

United States: Mayo Clinic hand hygiene initiative: Eliminating antimicrobial hand soaps (2017)

United States: Providence St. Patrick Hospital hand hygiene initiative: Eliminating hand soaps containing triclosan (2017)

United States: Kaiser Permanente Removal of antibacterial product from clinical soap and lotions (2010)

Gloves

Austria: Vienna Hospital Association Stockholm County Council (p. 16) (2004)

Czech Republic: Na Homolce Hospital (p. 17) (2004)

Sweden: Single-use health care products in Region Skåne, Sweden (p. 8) (2018)

United Kingdom: Great Ormond Street Hospital, National Health Service 'Gloves are off' campaign case study (2018)

United States: Kaiser Permanente moves away from PVC gloves

Integrated pest management

Rationale

Controlling pests in health care facilities is important to prevent vector-borne disease transmission and maintain cleanliness. However, pest control chemicals can pose health risks. Pesticides work by interfering with necessary biological processes in pests. Because many organisms share similar biological processes, the effects of pesticides are often not specific to one type of organism. Pesticides can kill their targets but may also harm other organisms, including humans.

The majority of health care institutions use chemical pesticides on a regular basis, both inside and outside. Pesticides expose patients, staff, and visitors to toxic chemicals through inhalation, ingestion, or absorption. Health care facilities are unique in that a large portion of occupants are sick. They can be immunocompromised or have neurological, reproductive, or respiratory systems that put them at increased risk of harmful effects from exposure to pesticides. Elderly persons, people who are chemically sensitive, pregnant women, newborns, and children are also vulnerable. According to the U.S. Department of Veterans Affairs, "pest management in health care facilities differs from control practices in other types of institutions. The effect on patients in various stages of debilitation and convalescence... requires that a cautious, conservative policy be adopted concerning all uses of pesticides."

Pesticide exposures are also widespread in the general population. The U.S. Department of Agriculture has estimated that 50 million people in the United States obtain their drinking water from groundwater that is potentially contaminated by pesticides and other agricultural chemicals. Pesticide exposures can cause a wide variety of symptoms and reactions, depending on the type of pesticide and the amount, duration, circumstances, and pathways of exposure. Numerous pesticides, either in isolation or in combination, can act as endocrine disruptors, neurodevelopmental toxicants, immunotoxicants, and carcinogens. Exposure can damage the reproductive, nervous, and immune systems and contribute to respiratory illness including impaired lung function and asthma. Chronic exposure to low doses of some pesticides can cause problems in the central nervous system, delayed development, cancer, and alterations to the immune and endocrine systems. Epidemiological studies have demonstrated a correlation between low-dose prenatal and postnatal exposure to pesticides and an increase in miscarriages and congenital disorders.

Pesticide use generally represents an ongoing global health threat. A study released in late 2020 showed pesticide poisonings on farms around the world have risen dramatically since the last global assessment 30 years ago. Researchers conclude that there are about 385 million cases of acute poisonings each year, up from an estimated 25 million cases in 1990. That means about 44% of the global population working on farms — 860 million farmers and agricultural workers – are poisoned every year. Unintentional and self-inflicted acute poisonings by pesticides are a serious public health problem in many parts of the world, with ingestion of pesticides being one of the most common methods of suicide and attempted suicide. While beyond the scope of this chapter, organic food procurement in health care settings should be a priority to address this public health crisis.

Since the introduction of synthetic pesticides at the beginning of the 1940s, their global consumption has grown significantly and was estimated to be 5.6 billion pounds globally in 2000. Once released into the environment, they can pollute rivers, groundwater, air, soil, and food sources. WHO has singled out highly hazardous pesticides for priority elimination.

Integrated pest management (IPM) is an ecosystem-based strategy for pest control that eliminates or greatly reduces the use of dangerous pesticides. The strategy focuses on long-term prevention of pest infestations. It requires consideration of all available pest control techniques and integration of appropriate measures meant to discourage the development of pest populations. IPM focuses on least toxic management of pests (both internal and external to health care facilities) through prevention actions such as improved sanitation, building maintenance, mechanical and biological controls, and better practices (see appendix 3 for an IPM practices checklist).

Conventional pest control programs tend to focus on killing pests while ignoring the reasons they appear in the first place, which doesn't prevent recurring problems.

By removing or altering conditions conducive to infestations, IPM practitioners can better address existing infestations and prevent future ones. IPM programs tend to be more cost-effective in the long term because they prevent problems rather than repeatedly addressing the same symptoms, while avoiding the expense and potential hazards of toxic pesticides. IPM has also been demonstrated to be more effective in controlling pests over time, because it combines many control techniques instead of relying on any one strategy. IPM's efficacy advantage has been confirmed by research and practice in health care facilities. IPM is recommended by the U.S. Environmental Protection Agency, the CDC, the American Hospital Association, and many international bodies.

Using an IPM approach means focusing on prevention. Least toxic pesticides are used only as a last resort after other methods have failed and monitoring indicates pesticides are needed according to established guidelines. Any application of pesticides should focus on removing only the target organism. Pest control materials should be selected and applied in a manner that minimizes risks to worker and patient health, beneficial and nontarget organisms, and the environment.

Key considerations

- It is important to design, construct, renovate, and maintain buildings to be as pest resistant as possible.
- Use only pesticides specific to the current infestation when biological and mechanical controls have proven insufficient, selecting the least hazardous option available.
- When pesticides must be used as a last resort, always use the least toxic option and:
  - Notify any potentially exposed staff, patients, and visitors that a pesticide application is under way to allow people to avoid exposure.
  - Obtain and communicate information provided by manufacturers (e.g. safety data sheets) on pesticide formulations and safety protocols.
  - Supply and ensure use of appropriate personal protective equipment.
  - Ensure protective clothing is regularly and safely washed.
  - Train pesticide applicators in the appropriate use of pesticides.
  - Ensure proper storage of pesticides to prevent access by the general public or unauthorized use.
  - Avoid applying sprays.

Pesticides hazard summary and alternatives chart

Hazard summary	Alternatives summary
For control of pests and weeds, various pesticides and herbicides including organophosphate and organochlorine compounds are used. • Long-term occupational exposure to **organophosphate insecticides** is linked to neuropsychological effects including difficulties in executive functions, psychomotor speed, verbal, memory, attention, processing speed, visual-spatial functioning, and coordination. • Long-term occupational exposure to **organochlorine pesticides** is linked to headaches, nausea, fatigue, muscle twitching, and visual disturbances. It may be associated with the development of blood dyscrasias, including aplastic anemia and leukemia in humans. • Short-term exposure can cause nausea, headaches, rashes, and dizziness. It is linked to cancer, birth defects, neurological and reproductive disorders, and the development of chemical sensitivities. • Some common pesticides contaminate food webs.	IPM for pest control includes employing best practices in prevention of environments conducive to pest infestations (see IPM practices checklist). • As a last resort, least toxic pesticides should be used (see EU pesticides database for approved and unapproved pesticides). • Pesticide Action Network searchable pesticides database

Tools and resources: Alternatives

Checklist | Integrated pest management checklist (appendix 3)

Report | Taking toxics out of Maryland's health care sector: Transitioning to green pest management practices to protect health and the environment. Integrated Pest Management in Health Care Facilities Project (2008)

Report | HCWH Healthy hospitals: Controlling pests without harmful pesticides including model policy, checklists, and case studies (2003)

Webinar | Practice Greenhealth Healthy hospitals: Managing facilities without toxic pesticides through integrated pest management (2011)

Website | Practice Greenhealth Integrated pest management

Website | Centers for Disease Control and Prevention Vector Control. Integrated Pest Management. US Centers for Disease Control classified training module

Tools and resources

Guidance |Practice Greenhealth Ten-step guide to implementing an IPM program

Guidance | Practice Greenhealth Ecowise integrated pest management contracting toolkit (2008)

Guidance | Practice Greenhealth Model integrated pest management landscape policy, model IPM plan, model IPM policy, suggested IPM RFP questions

Report | WHO Recommended classification of pesticides by hazard (2019)

Report | PAN International list of highly hazardous pesticides (2018)

Website | U.S. Environmental Protection Agency Integrated pest management

Case studies

Africa: GGHH Bongani Regional Hospital IPM case study (2018)

Argentina: GGHH Cordoba's Santísima Trinidad Children's Hospital integrated pest management case study (available in Spanish and English (2012)

South Africa: GGHH Mitchells Plain Hospital, Western Cape environment friendly rodent control project (2014)

United States: Beyond pesticides: Taking toxics out of Maryland's health care sector: Transitioning to green pest management practices to protect health and the environment Integrated Pest Management in Health Care Facilities Project (2008)

United States: HCWH Beyond pesticides: Healthy hospitals: Controlling pests without harmful pesticides (2003)

Safer medical devices

Rationale

While critical and life-saving, some medical devices can contain chemicals or materials that pose risks to human health and the environment. Bisphenol A (BPA) is one of the highest-volume chemicals produced worldwide. It is widely used in medical devices, and exposure is nearly ubiquitous. BPA is an endocrine disruptor and has been linked to human health effects. Polyvinyl chloride (PVC) is the fifth-most manufactured plastic globally and is commonly used in medical devices. The entire life cycle of PVC is associated with chemicals of concern. These are some of the most prominent chemicals of concern in medical devices and the focus of this chapter.

Polyvinyl chloride in medical devices

Globally PVC is the fifth-most commonly manufactured plastic at more than 60 million metric tons annually. PVC is one of most common polymers used in medical devices such as tubing, IV solution bags, blood bags, urine bags, oxygen masks, enteral nutrition products, IV infusion sets, bladder and vascular catheters, and disposable gloves, among others.

Although widely used in medical products, construction materials account for approximately 75% of all PVC use, including flooring, pipes, carpet backing, and wall coverings. Office furniture, supplies, and packaging can be made of PVC.
The entire life cycle of PVC is associated with chemicals

of concern, including the production of the base ingredient chlorine and the chemical building blocks that make up the polymer. Chemicals of concern are also created during use and disposal.

Chemicals of high concern are defined by GreenScreen benchmark 1 (a widely used international chemical evaluation tool). Benchmark 1 chemicals are of high concern to human health and the environment and consistent with global regulations like REACH. PVC can also result in the formation of highly toxic chemicals during manufacture and disposal by incineration including dioxin, a known human carcinogen. PVC can be challenging to recycle and has a lower recycling rate than most other plastics. Recycled PVC often contains hazardous chemicals. Other more sustainable plastics are widely available.

PVC typically requires more additives than most alternative polymers, and many of the additives have their own toxic properties, such as stabilizers and plasticizers. Because PVC is a rigid material, plasticizers are necessary to render it flexible, pliable, and elastic. Ortho-phthalates are a group of compounds long used to soften PVC and add flexibility. Diethylhexyl phthalate (DEHP) is the phthalate most commonly used in medical products. PVC products plasticized with phthalates are widely used in commerce as well as health care, resulting in ubiquitous exposure to the general public. Use of phthalates is widespread and includes furniture, flooring, toys, kitchen items, garden hoses, shower curtains, and sheathing for wires and cables.

Plasticizers in PVC products

PVC medical devices can contain up to 40% of plasticizers by weight. DEHP is not covalently bound to the plastic and has been found to leach from PVC medical devices into blood, blood products, lipophilic substances, and medical solutions.

DEHP is listed as a reproductive toxicant and endocrine disrupter under European chemical legislation. Concerns about DEHP exposure center primarily around findings from extensive laboratory animal testing showing that exposures during critical periods of development can interfere with testosterone production and disrupt normal male reproductive tract development. The National Toxicology Program's National Institute of Environment Health Sciences expressed concern about the potential impacts of DEHP on the developing reproductive tract of infant boys. Subsequently, FDA conducted a safety assessment of DEHP. In a 2002 public health notification, the agency advised health care professionals to switch to devices made of alternative materials that do not contain DEHP when treating patients who may be particularly vulnerable, including male neonates, pregnant women who are carrying male fetuses, and peripubertal males.

Subsequently, scientists from the Endocrine Society concluded that DEHP has the potential to act as an androgen disruptor. More recent studies in human populations confirm some of the adverse impacts of DEHP on male reproductive tract development first identified in many experimental animal studies. A systematic review also finds that higher exposures to DEHP are associated with sperm abnormalities and lower testosterone levels. Recent studies also show that prenatal exposure to phthalates is associated with adverse impacts on neurodevelopment, including lower IQ, problems with attention and hyperactivity, and poorer social communication.

Patients may receive high exposures to DEHP and its toxic metabolites, including mono ethylhexyl phthalate, when undergoing replacement of blood products, exchange transfusions, receipt of total parenteral nutrition or extracorporeal membrane oxygenation, and other procedures. The National Toxicology Program Center for the Evaluation of Risks to Human Reproduction reported serious concerns that certain intensive medical treatments of male infants may result in levels of DEHP exposure that affect development of the male reproductive system.

The European Union's Scientific Committee on Emerging and Newly Identified Health Risks issued a final opinion on the use of PVC medical devices containing DEHP. They concluded the use of "PVC medical devices may lead to a higher exposure to DEHP compared to everyday sources affecting the general population. Examples of medical procedures with a potential for high exposure to DEHP are multiple procedures in preterm neonates, haemodialysis, heart transplantation or coronary artery bypass graft surgery, massive blood transfusion of red blood cells, and plasma or peritoneal dialysis."

PVC/DEHP-containing device hazard summary and alternatives chart

PVC is used in a wide array of medical devices. This chart represents a fraction of those products.

<table>
<tr><th>Hazard summary</th><th>Priority PVC and DEHP-containing products</th><th>Alternatives summary</th></tr>
<tr><td rowspan="8">PVC requires highly toxic inputs during manufacture including vinyl chloride, a known human carcinogen. PVC can also result in the formation of highly toxic chemicals during manufacture and disposal by incineration including dioxin, a known human carcinogen.

DEHP (a plasticizer additive) is listed as a reproductive toxicant by the European Union and the state of California. DEHP is an endocrine disruptor.</td><td>Breast pumps and accessories</td><td rowspan="8">Alternative materials include silicone, polyolefins. Multilayer films are mainly PP, SEBS, SEBS-PE, PP, PET, PA, PS, PC.

Find alternatives to PVC and DEHP-containing devices here:
• Nordic Swan-labeled products for disposable bags, tubes, and accessories for health care.
• Safer medical devices database
• U.S. government: Green procurement database
• National Agency for Public Procurement in Sweden provides procurement criteria for safer alternatives in the health care sector
• The chemicals substitution by INERIS website in France.</td></tr>
<tr><td>Enteral nutrition products</td></tr>
<tr><td>Enteral tubes</td></tr>
<tr><td>General urological</td></tr>
<tr><td>Gloves (see hand hygiene section)</td></tr>
<tr><td>Parenteral infusion devices and sets</td></tr>
<tr><td>Respiratory therapy products</td></tr>
<tr><td>Vascular catheters</td></tr>
</table>

Bisphenol A in medical devices

Bisphenol A (BPA) is used to make polycarbonate plastic, epoxy resins, and other applications. Polycarbonate plastics have many applications including use in food and drink packaging, water and infant bottles, impact-resistant safety equipment, and medical devices. Epoxy resins are also used as lacquers to coat metal products such as food cans, bottle tops, and water supply pipes. Some dental sealants and composites may also contribute to BPA exposure.

Medical applications include tubing, blood oxygenators, dialysers, intravenous administration sets, syringes, catheters, nebulizers, humidifiers, haemodialysis membranes, autotransfusion apparatus, intravenous fluid bags, nasogastric and enteral feeding tubes, respiratory masks, endotracheal tubes, and umbilical catheters, among others. BPA is known to leach out of polycarbonate plastics.

BPA is one of the highest-volume chemicals produced worldwide, and exposure is nearly ubiquitous in high income countries. BPA is an endocrine disruptor and has been linked to human health effects. BPA has been shown to play a role in the pathogenesis of several endocrine disorders including female and male infertility, precocious puberty, hormone-dependent tumours such as breast and prostate cancer, and several metabolic disorders including polycystic ovary syndrome.

BPA is listed as a reproductive toxicant and endocrine disrupter under European chemical legislation. The National Toxicology Program reports some concern for effects on the brain, behavior, and prostate gland in fetuses, infants, and children. The Journal of American Academy of Pediatrics reported that medical devices were positively associated with urinary BPA concentrations. California's Office of Environmental Health Hazard Assessment has listed BPA as a reproductive toxicant.

The Scientific Committee on Emerging and Newly Identified Health Risks in the European Union concluded that risk for adverse effects may exist when BPA is directly available for systemic exposure after non-oral exposure routes, especially for neonates in intensive care units, infants undergoing prolonged medical procedures, and dialysis patients. “Although the benefit of **medical devices must be considered, the committee recommends that, where practicable, medical devices that do not leach BPA should be used**. The possibility of replacing BPA in these products should be considered against their efficiency in the treatment, as well as the toxicological profile of the alternative materials”.

BPA-containing medical device hazard summary and alternatives chart

<table>
<tr><th>Hazard summary</th><th>BPA-containing products
See this Scientific Committee on Emerging and Newly Identified Health Risks report for a longer list of products that may contain BPA.</th><th>Alternatives summary</th></tr>
<tr><td rowspan="5">BPA is a component of a variety of different plastics including polycarbonate. BPA is an endocrine disruptor and has been linked to human health effects. Toxicity studies indicate that the kidney and liver are relevant target organs for BPA toxicity.</td><td>Polycarbonate: Eye lenses (glasses), tubing, blood oxygenators, dialysers, intravenous administration sets, syringes, catheters</td><td rowspan="5">See the safer medical devices database for alternatives to BPA-containing devices.

The chemicals substitution by INERIS website in France. National Agency for Public Procurement

in Sweden provides procurement criteria for safer alternatives in the health care sector.

Nordic Swan-labeled products</td></tr>
<tr><td>Polysulfone: Surgical trays, nebulizers, humidifiers, haemodialysis membranes</td></tr>
<tr><td>Polyacrylates: Dental composite resins, dental sealants, coating for medical devices</td></tr>
<tr><td>Polyetherimide: Sterilisation trays, dentist devices, pipettes</td></tr>
<tr><td>BPA uses as additive for PVC as in the following products: Autotransfusion apparatus, intravenous fluid bags, nasogastric and enteral feeding tubes, respiratory masks, endotracheal tubes, umbilical catheters</td></tr>
</table>

Tools and resources: Alternatives

Database | Europe: HCWH Safer medical devices database covers a range of products and lists alternatives that do not contain PVC and phthalates.

Database | Nordic countries: Nordic Swan-labeled products include alternatives in multiple product categories.

Database | Sweden: National Agency for Public Procurement in Sweden provides procurement criteria for safer alternatives in the health care sector.

Database | United States: U.S. government green procurement database contains some medical product lists that do not contain PVC and phthalates.

Fact sheet | United States: HCWH Alternatives to PVC medical devices for the neonatal intensive care unit (2008)

Website | HCWH Sustainable procurement resources

Website I France: The chemicals substitution by INERIS website offers alternatives for bisphenols, phthalates, and alkylphenol ethoxylates.

Tools and resources

Fact sheet | HCWH Sustainable procurement quick guide: Gloves

Fact sheet | HCWH Sustainable procurement quick guide: Reducing PVC and DEHP in IV bags (2020)

Fact sheet | HCWH Sustainable procurement quick guide: Reducing PVC and DEHP in medical products (2020)

Fact sheet | HCWH Medical devices regulation: An engine for substitution? (2017)

Fact sheet | HCWH Hazardous chemicals in medical devices: Phthalates (2013)

Fact sheet | HCWH Hazardous chemicals in medical devices: Bisphenol A (2013)

Fact sheet | HCWH How to survey PVC use in your hospital and begin a successful PVC phase-out program (2007)

Fact sheet | HCWH PVC/DEHP phase-out is possible anywhere in Europe: Model hospitals show how to succeed (2007)

Fact sheet | HCWH Why health care is moving away from the hazardous plastic polyvinyl chloride (2006)

Infographic | Non-toxic health care: Reducing risks with safer alternatives

Report | HCWH Polyvinyl chloride in health care: A rationale for choosing alternatives (2020)

Report | HCWH Non-toxic health care: Alternatives to phthalates and bisphenol A in medical devices, (2nd edition, 2019)

Report | HCWH Endocrine-disrupting chemicals in health care: Reducing exposures for patients Final report of the workshop organised by Health Care Without Harm Europe to address the implementation of the Medical Devices Regulation (MDR) (2019)

Report | HCWH Can the medical devices regulation be an engine for substitution? Final report of the workshop organised by Health Care Without Harm Europe in the European Parliament (2017)

Report | HCWH Non-toxic health care: Alternatives to phthalates and bisphenol A in medical devices (2014)

Report | Clean production action: The plastics scorecard v.1.0 (2014)

Report | HCWH Towards non-toxic health care. Final report of the lunch seminar organised by Health Care Without Harm Europe in the European Parliament (2013)

Report | HCWH The weight of the evidence on DEHP: Exposures are a cause for concern especially during medical care (2009)

Report | HCWH Preventing harm from phthalates: Avoiding PVC in hospitals (2004)

Report | HCWH DEHP exposures during the medical care of infants: A cause for concern (2002)

Report | HCWH Neonatal exposure to DEHP (di-2-ethylhexyl phthalate) and opportunities for prevention (2002)

Report | HCWH Aggregate exposures to phthalates in humans (2002)

Webinar | HCWH Medical devices regulation: Heading in the right direction? (2018)

Webinar | The new medical devices regulation: An engine for EDC substitution? (2016)

Webinar | PVC-free blood bag webinar (2015)

Webinar | EDCs in health care (2014)

Government reports

Report | European Commission: Scientific Committee on Emerging and Newly Identified Health Risks Opinion on the safety of the use of bisphenol A in medical devices (2015)

Report | European Commission: Scientific Committee on Emerging and Newly Identified Health Risks Opinion on the safety of of medical devices containing DEHP, plasticized PVC, or other plasticizers on neonates and other groups possibly at risk (2015)

Report | U.S. FDA Safety assessment of Di(2-ethylhexyl) phthalate (DEHP) released from PVC medical devices

Report | U.S. FDA public health notification: PVC devices containing the plasticizer DEHP (2002)

Report | FDA DEHP resources: Medical devices made with PVC using the plasticizer DEHP; draft guidance for industry and FDA (2002)

Database | French Agency for Food, Environmental, and Occupational Health and Safety searchable database

Report | Comprehensive list of government studies and reports on DEHP

Case studies

Austria: PVC-free neonatology (2010)

PVC/DEHP phase-out is possible anywhere in Europe: Model hospitals show how to succeed (2007)

Europe: Non-toxic health care: Alternatives to phthalates and bisphenol A in medical devices, (2nd edition, 2019)

Europe: Non-toxic health care: Alternatives to phthalates and bisphenol A in medical devices (2014)

Europe: PVC/DEHP phase-out is possible anywhere in Europe: Model hospitals show how to succeed (2007)

Europe: Case studies from: Austria, Czech Republic, Denmark, Slovakia, and Sweden (2007)

United States: Attaining 100% DEHP elimination in IV bags Miller Children's Hospital (2003)

United States: Evergreen Hospital NICU strives to become DEHP- and PVC-free (2006)

United States: Lucile Packard NICU makes major strides to remove DEHP and saves $200,000 by switching to custom-made DEHP-free IV product (2003)

United States: Kaiser Permanente DEHP minimization in intravenous administration sets (2008)

United States: Kaiser Permanente PVC- and DEHP-free respiratory therapy products in NICU (2011)

United States: Kaiser Permanente PVC-free signage (2011)

United States: Kaiser Permanente PVC- and DEHP-free split-tip chronic dialysis catheters (2010)

United States: Kaiser Permanente PVC and DEHP in neonatal intensive care units

United States: Kaiser Permanente PVC- and DEHP-free patient ID bands (2009)

United States: Kaiser Permanente PVC-free gloves and other products (2015)

Appendices

Appendix 1: Summary of chemical priorities in health care

Summary of chemical priorities in health care

This matrix offers a summary of chemical and material priorities in health care. **This is not meant to be a comprehensive review of the issues, health impacts, or risks**. See individual chapters for more detailed information. Any health impacts from chemicals will be the result of multiple factors including the dose, timing, and duration of exposure.

Summary of chemical priorities in health care

Hospital uses and exposed populations	Chemicals of concern	Key health and environmental concerns	Safer alternatives summary
Mercury-containing products • Mercury can be found in thermometers, gauges, blood pressure cuffs, and many other medical devices as well as dental amalgam. • May also be used in the production of chlorine. **Exposed population:** • Health care workers • Community members living in production and disposal areas • Wildlife and aquatic life	Mercury	• Mercury is a potent neurotoxicant that can harm the brain, spinal cord, kidneys, and liver. • Mercury can contaminate the food web. • The Minamata Convention on Mercury, an international treaty signed by 116 countries, mandates the substitution of non-mercury alternatives for many mercury-containing products, including those used in health care.	• Alternatives to all uses of mercury are widely available and vary depending on the use. See **mercury** section for more.
Sterilants and disinfectants • Used for both surface and instrument disinfection **Exposed population**: • Health care workers • Maintenance workers • Disposal workers • Patients and visitors	Glutaraldehyde Ethylene oxide Bleach (sodium hypochlorite) in open containers Quaternary ammonium compounds Formaldehyde	• Glutaraldehyde is a potent occupational skin irritant and sensitizer that can cause and exacerbate asthma. • Ethylene oxide is flammable and explosive, a known human carcinogen, a toxic air contaminant, and an ozone depleter. It is a respiratory irritant and can cause lung injury. Chronic exposure has been associated with cancer, reproductive effects, mutagenic changes, neurotoxicity, and sensitization.	• Limit disinfecting only to areas requiring it. • Where disinfectants are required, select least toxic disinfectants. • Redesign cleaning processes. For more information see the WIDES database.

• Community members living in production and disposal areas • Wildlife and aquatic life		• Some quaternary ammonium compounds are respiratory sensitizers that can cause contact dermatitis and cause or exacerbate asthma. • Chlorine bleach (sodium hypochlorite in open containers) can liberate chlorine gas, a respiratory irritant and sensitizer. • Formaldehyde is a carcinogen and can cause nasal and eye irritation, neurological effects, and increased risk of asthma. • For additional sterilants and disinfectants of concern, see the sterilants and disinfectants chapter	
Cleaning chemicals **Exposed population**: • Health care workers • Patients and visitors • Maintenance workers • Disposal workers • Community members living in production and disposal areas • Wildlife and aquatic life	Ingredients may include VOCs, certain surfactants, disinfectants, solvents, metals like mercury, and fragrances	• Cleaning agents may contain volatile organic compounds that can contribute to poor indoor air quality and may contain chemicals that cause cancer, reproductive disorders, respiratory ailments, eye and skin irritation, and central nervous system impairment. They can also contain: • Certain surfactants such as alkylphenol ethoxylates that degrade into nonylphenol, which is toxic to aquatic wildlife; • Fragrances that can pose hazards and are unnecessary; • Disinfectants (see above for concerns and alternatives). • For additional cleaning chemicals of concern, see Stockholm County Council's phase-out list for chemicals hazardous to the environment and human health.	• Less toxic cleaning agents are widely available and used. Nordic Swan, GreenSeal and EcoLogo certify cleaners with lower environmental and human health toxicity. • See also WIDES database.
Hand hygiene **Exposed population:** • Health care workers • Patients & visitors • Community members living in production and disposal areas • Wildlife and aquatic life	Triclosan, triclocarban, silver, other compounds	• Triclosan, triclocarban, and 23 other substances were restricted from products used in health care by the U.S. Food And Drug Administration. • The European Union restricts the level of triclosan in some products, including hand soaps. • Triclosan is widely found in the bodies of health care workers, the general population, and the environment and can have adverse effects. • Triclosan could play a role in fostering antibiotic-resistant strains of bacteria. • Triclocarban is environmentally persistent, detectable in many rivers and streams, and tends to bioaccumulate in many invertebrates.	• For non-clinical uses, soap and water or alcohol products are sufficient. • For areas requiring disinfection, see above. • See also WIDES database.

		• Triclocarban shares toxic properties with triclosan, including hormonal effects. • Silver preparations in soap are not recommended by the U.S. Centers for Disease Control for hand hygiene in hospitals.	
Pesticide /integrated pest management (for control of pests) **Exposed population:** • Pesticide applicators • Health care workers • Patients and visitors • Maintenance workers • Community members living near production and use areas • Wildlife and aquatic life	Various pesticides and herbicides including organochlorine and organo-phosphate compounds	• Chronic occupational exposure to widely used organophosphate insecticides are linked to neuropsychological effects including difficulties in executive functions, psychomotor speed, verbal, memory, attention, processing speed, visual-spatial functioning, coordination, and COPD. • Long-term occupational exposure to widely used organochlorine pesticides is linked to hypertension, cardiovascular disorders, headaches, nausea, fatigue, muscle twitching, and visual disturbances, development of blood disorders, including aplastic anemia and leukemia in humans. Organochlorines act as endocrine-disrupting chemicals. Short-term exposure can cause nausea, headaches, rashes, and dizziness. They are also known for their high toxicity, slow degradation, and bioaccumulation • Some pesticides contaminate food webs.	• IPM for pest control includes best practices in prevention of environments conducive to pest infestations. • Remove sources of attraction for pests. See appendix 3.
Safer medical devices Chemicals of concern can be found in PVC enteral nutrition products; enteral tubes; general urological devices; gloves; parenteral infusion devices and sets; respiratory therapy products; and vascular catheters. **Exposed population:** • Patients • Community members living in production and disposal areas	PVC DEHP and other ortho-phthalates Bisphenol A	• Polyvinyl chloride is a particularly problematic plastic because of the toxicity of chlorine production and the chemical intermediates required to make the polymer. There is also the generation and release of hazardous compounds during manufacture and disposal. • PVC requires additives, many with their own toxic properties. • The material is challenging to recycle. • DEHP, a plasticizer used in PVC medical products, can damage the liver, kidneys, lungs, and reproductive system, particularly developing testes. • The European Union's Scientific Committee on Emerging and Newly Identified Health Risks issued a final opinion on the use of PVC medical devices containing DEHP. They concluded the use of PVC medical devices may lead to higher exposure to DEHP.	• PVC- and DEHP-free alternatives are available for many uses, with some geographic restrictions. • See the safer medical devices database for examples.

		• In animal studies, BPA is associated with alteration in breast, prostate, and brain development, changes in behavior, and susceptibility to breast and prostate cancer. • The European SCENIHR recommends that, where practicable, medical devices that do not leach BPA should be used. • The U.S. Food and Drug Administration expressed some concern about potential effects of BPA on the brain, behavior, and prostate glands in fetuses, infants, and young children.	
HIPO list of priority product categories	**To find an additional list of priority product categories see the** sustainable procurement in health care guide (annex 4). For additional priority chemicals of concern, see Stockholm County Council's phase-out list for chemicals hazardous to the environment and human health.		
Authoritative lists, chemicals, and materials to consider for prioritization	**Important lists of chemicals of concern** • Practice Greenhealth's standardized environmental criteria (found in the sustainable procurement in health care guide (annex 6) • Stockholm County Council's phase-out list for chemicals hazardous to the environment and human health • International Chemical Secretariat (Europe) SIN list for chemical substitution • Health Care Without Harm chemicals of concern for the health sector **Important authoritative lists** • Stockholm Convention persistent, bioaccumulative, and toxic substances chemicals • Rotterdam Convention chemicals and pesticides • IARC group 1 and group 2A list of probable and known human carcinogens • REACH chemicals of very high concern and REACH restricted substances • CA proposition 65 listed chemicals (carcinogens, mutagens, reproductive toxicants) **Health Care Without Harm list of chemicals of concern** • Practice Greenhealth's standardized environmental criteria (found in sustainable procurement in health care guide (annex 6) plus VOCs		
Summary of additional chemical and material priorities in health care			
The priority categories described below are not currently covered in this chemicals guide, though they remain priorities. See linked sources for additional information.			
Latex- containing products **Exposed populations:** • Health care workers • Patients and visitors	Natural rubber latex	Frequent use of latex products may lead to the development of allergies to latex proteins, with resulting allergic reactions varying from mild to life-threatening. The reporting of allergic reactions to latex dramatically increased due to the increased	Powder-free, low-protein gloves or non-latex gloves. Many non-latex alternatives exist; PVC should not be

• Community members living in production areas		use of latex gloves. Prevalence studies indicate that 6 to 17% of health workers developed a latex allergy at the height of the use of powdered latex gloves.	used. See gloves section above.
Lab chemicals **Exposed populations:** • Health care workers • Maintenance workers • Disposal workers • Community members living in production and disposal areas • Wildlife and aquatic life	Many including toluene and xylene (used to fix tissue specimens and rinse stains) Formaldehyde Mercury salts and oxides See this list for other priorities.	• Xylene can depress the central nervous system, with symptoms such as headache, dizziness, nausea, and vomiting. • Many solvents cause eye and respiratory irritation. • Toluene is a neurodevelopmental toxicant, and chronic exposure can cause laryngitis, bronchitis or bronchial pneumonia, and conjunctivitis. • Formaldehyde is a carcinogen. • Mercury is a potent neurotoxicant. • For additional lab chemicals of concern, see Stockholm County Council's phase-out list for chemicals hazardous to the environment and human health.	• Substitution with safer alternatives where available is preferable to process controls and/or personal protective devices.
Electronics **Exposed populations:** • Health care workers • Patients and visitors • Maintenance workers • Community members living in production and disposal areas	Materials used in electronics include: • Metals like lead and mercury • Brominated flame retardants • Chlorinated plastics	• Improper disposal of electronic equipment poses a significant threat to public health and the global environment. When electronic products are incinerated or dumped in a landfill, they can release heavy metals, dioxins, and other hazardous substances that contaminate groundwater and pollute air. • Brominated flame retardants result in toxic polybrominated dibenzo dioxins and furans when recycled. Markedly elevated levels of these are measured in recyclers and in communities hosting recycling operations. Health effects include cancer and immune and reproductive system toxicity. • Electronic use may contribute to elevated levels of flame retardants in indoor dust and in humans.	Electronics manufacturers are developing less toxic alternatives to the most hazardous components in response to international regulation and consumer demand. Light bulbs and batteries are easiest to change in the short term. For more see EPEAT, and Nordic Swan.
Flooring (Carpet and resilient flooring) **Exposed populations:** • Health care workers • Patients and visitors • Maintenance workers	• Flame retardants • Polyvinyl chloride • Perfluorinated compounds (PFAS) • Antimicrobials	• All chemical flame retardants currently on the market have some hazards associated with them. Toxic effects include reproductive, neurocognitive, and immune system impacts. • PVC generates serious pollution during production and disposal and often requires toxic additives.	Healthy resilient flooring guidance with criteria List of products that meet the criteria Healthy carpet guidance with criteria

• Community members living in production and disposal areas	• Azo dyes • Polyurethanes • Isocyanates • Alkylphenols	• PFAS persist in the environment and build up in people and the food chain, and some have been associated with cancer, reproductive and developmental impacts, and endocrine disruption. • Antimicrobials have toxic properties. They have not been demonstrated to be necessary or effective. They can contribute to antimicrobial resistance.	Blue Angel Nordic Swan
Furnishings **Exposed populations:** • Health care workers • Patients and visitors • Maintenance workers • Community members living in production and disposal areas	• Formaldehyde • Flame retardants • Polyvinyl chloride • Perfluorinated compounds • Antimicrobials • Azo dyes • Metals	• Formaldehyde is a known human carcinogen. • All chemical flame retardants currently on the market have some hazards associated with them. Toxic effects include reproductive, neurocognitive, and immune system impacts. • PVC generates serious pollution during production and disposal and often requires toxic additives. • PFAS persist in the environment and build up in people and the food chain, and some have been associated with cancer, reproductive and developmental impacts, and endocrine disruption. • Antimicrobials have toxic properties. They have not been demonstrated to be necessary or effective. They can contribute to antimicrobial resistance.	Healthy interiors furniture guidance with criteria List of products that meet the criteria See additional materials here. Blue Angel Nordic Swan
Developer liquids and X-Rays **Exposed populations:** • Health care workers • Maintenance workers • Community members living in production and disposal areas	• Silver X-ray filler, 1 to 5% hydroquinone developer, lead foil to shield X-rays, cleaners for X-ray developer systems contain chromium, Monomethyl-p-aminophenol sulfate, etc.	• Lead is a potent neurotoxicant. • Silver is an aquatic toxicant. • Developer powders are highly toxic by inhalation and moderately toxic by skin contact due to the alkali and developers themselves. Developers are also skin and eye irritants and in many cases strong sensitizers. • For additional chemicals of concern, see Stockholm County Council's phase-out list for chemicals hazardous to the environment and human health.	Digital imaging in health care and dentistry
Building materials **Exposed populations:** • Health care workers	Building materials have significant health and environmental impacts. See GGHH guide on buildings for more information. Health Care Without Harm has also developed criteria and advice for purchasing healthier furniture, flooring and carpet.		

• Construction workers • Patients and visitors • Maintenance workers • Community members living in production and disposal areas	• Asbestos • Formaldehyde • Metals • PBTs • BPA • Flame retardants • PVC • PFC • VOC	The construction and use of buildings consumes billions of tons of raw materials including many toxic chemicals, generates significant waste, consumes a tremendous amount of energy, and contributes toxic emissions to the air. Materials and furniture used indoors can degrade indoor air quality contributing to disease. Persistent bioaccumulative toxicants (PBT) can contribute to environmental pollution during manufacture, transport, use, and/or disposal. PBT chemicals released to the environment can contaminate the food web. Asbestos and formaldehyde are carcinogens. PVC, a widely used material, is toxic throughout its life cycle.	There are significant opportunities to improve environmental quality and human health through sustainable planning, design, and construction of health care facilities. HomeFree Blue Angel Nordic Swan
Smoking **Exposed populations:** • Health care workers • Patients and visitors • Maintenance workers	Tobacco and numerous associated toxic chemicals	Smoking and second-hand smoke have been linked to a long list of diseases and conditions including cancer, heart disease, COPD, and asthma. Smoking is hazardous to the developing child.	A complete smoking ban on the hospital site is recommended to protect patients and employees.
Pharmaceuticals	Pharmaceuticals have significant health and environmental impacts. See GGHH pharmaceuticals website for more information.		

Appendix 2: Responsibilities chart

Responsibilities chart

The following chart suggests roles and responsibilities
for members of your facility's sustainability team.

Hospital department, roles, and responsibilities	Activities	Your facility checklist
Environmental health safety team, hygiene, occupational health team		
• Help research, develop, and implement policy and procedures	✓	
• Maintain training records	✓	
• Enforce policy in action	✓	
• Provide training to new employees	✓	
Managers/supervisors		
• Make the commitment/sign a pledge/develop a policy	✓	
• Support or help convene team	✓	
• Ensure provision of alternative products and procedures	✓	
• Ensure incorporation of this initiative into training	✓	
• Ensure incorporation of this initiative into evaluations and promotions	✓	
Infection prevention		
• Help research, develop, implement, and evaluate policy and procedures	✓	
• Ongoing inspection, evaluation, and follow-up	✓	
• Lead sustainability efforts that intersect with infection prevention	✓	

Clinical staff		
• Help research, develop, implement, and evaluate policy and procedures	✓	
Purchasers		
• Help research safer alternatives	✓	
• Build the case for safer alternatives including building the business and safety case and considering total cost of ownership	✓	
• Engage appropriate staff in important procurement decisions	✓	
• Institutionalize safer purchasing policy and practice at the institution	✓	
Maintenance staff		
• Help research, develop, and implement policy and procedures	✓	
• Help develop training and communication around the policy or change	✓	
• Help provide feedback to evaluate and improve new practices	✓	
• Help implement changes	✓	
Food service		
• Help research, develop, and implement policy and procedures where related to food service	✓	
• Help develop training and communication around the policy or change	✓	
• Help provide feedback to evaluate and improve new practices	✓	
• Help implement changes	✓	

Appendix 3: Integrated pest management practices checklist

Integrated pest management practices checklist

Does your facility:	✓
• Learn about the pest species common to your location and present in the facility and identify the species posing the greatest danger?	
• Conduct a walk-through audit on a regular basis?	
• Report, log, and address all pest sightings?	
• Regularly inspect facilities for conditions that may lead to pest infestation?	
• Promptly unpack and recycle cardboard and wooden pallets as soon as possible after receiving them?	
• Eliminate storage of products in cardboard or on pallets? Remove all cardboard boxes in storage areas?	
• Store all items off the floor?	
• Install mosquito nets in windows, floor drains, and all air inlets and outlets in medical buildings and waste storage areas?	
• Create at least a six-inch wide vertical inspection space between the wall and all storage racks, equipment, and appliances? (Any equipment that produces heat (e.g., ice makers, appliances) needs special attention.)	
• Install door stripping and sweeps for 100% of doors and make sure they completely cover all gaps?	
• Repair cracks in walls; maintain air curtains properly? • Seal up potential pest entry points? Anything passing through a wall (pipe, wire, conduit, light switches, electrical outlets) should have a cover around it attached to the wall. • Eliminate cracks and holes throughout the facility to keep pests out?	
• Inspect anything with tube framing (tables, chairs) regularly? Enclose when possible.	
• Check caulk and grout yearly for any gaps? • Check services and critical areas for holes and cracks in the masonry and repair them?	
• Inspect building roofs for any pest entry portals and seal roof parapets and caps?	

• Install and regularly check bird netting where needed?	
• Store mops with heads up or hang mops off of the floor when not in use?	
• Discourage all food storage outside food areas? Regularly check rooms for unauthorized food storage?	
• Ensure that food and food waste are kept in sealed containers?	
• Implement and enforce sanitation procedures to limit pests' access to food and drink? Regularly check for residues that can serve as food for pests?	
• Keep filing cabinets away from food and water?	
• Separate loading docks from garbage areas?	
• Inspect sink and floor drains daily for residue/buildup; inspect U-traps regularly; and seal leaks in plumbing promptly?	
• Properly manage composting and food waste in relevant areas?	
• Maintain "bug lights" by clearing out trapped insects regularly and replacing bulbs as needed?	
• Use physical barriers to block pest entry and movement (screens at chimneys and air intakes, window screens)?	
• Fix moisture problems (leaks and condensation on pipes)?	
• Remove all plants within three feet of the entire exterior?	
• Use native, perennial plants in garden areas, as these are less likely to require pesticide protection?	
• Track and log all use of toxic pesticides over time?	
• Use least toxic pesticides and only as a last resort?	
• Use and regularly check bait stations (as a last resort) instead of sprays?	
• Ensure that devices such as bait stations placed in outside areas are locked, secured, clean, and in good working order?	

Appendix 4: Putting it all together: Elements of an action plan

Elements of an action plan

The steps outlined in this plan are meant to help create a structure and to provide a roadmap for taking action at your facility. They can be tackled simultaneously or in any order that works best. For a comprehensive look at developing and implementing a sustainable procurement program, see the sustainable procurement in health care guide.

Identify a working group or team

It is very important to identify a team or working group to create a successful program. Different activities are likely to require different expertise and roles in the facility. Working groups may be stand-alone committees, subcommittees of procurement groups, or an occupational health and/or infection prevention committee. For example, if you already have a Global Green and Healthy Hospitals (GGHH) agenda implementation team, you could create a special chemicals subcommittee. Some initiatives will impact many people within a facility or involve changing long-standing protocols, so collaboration with a cross-program team will help the effort succeed. The group should have the support of hospital management. See the responsibilities chart for a review of hospital personnel that could be included on a team.
Harmful chemicals may be present in a variety of places and products within your facility, so the substitution and/or safe handling of these chemicals must involve all relevant sectors and employee groups. Engaging those who routinely handle targeted products is as important as engaging purchasing or sourcing departments. It is helpful if the working group is cleared to issue recommendations and technical standards, communicate with relevant staff about the initiatives, and develop and carry out internal training, evaluation, and communication. Effective training and education programs will be critical. The more people who understand the hazards involved and the alternatives available, the more successful the program will be.

Tools and resources

Guidance | HCWH Sustainable procurement in health care guide

Website | HCWH Sustainable procurement resources

Prioritize areas for action

Prioritizing areas for action will require research and consultation with appropriate staff. GGHH has identified six target priority areas for action: mercury, sterilants and disinfectants, cleaning agents, hand hygiene and glove products, pesticides, and PVC and DEHP-containing medical devices. A broader list of priorities has been identified in the Health Care Without Harm high-priority product category list (see annex 4). Your team may want to do your own evaluation and determine your facility-specific priorities.

Health Care Without Harm has developed a tool to help your organization prioritize products or services within your institution (see annex 3). Another way to identify priorities is to conduct a department survey of health and safety or environmental issues identified by staff. Any serious health and safety problems already present at your facility should be a priority for substitution and interventions to assure safety for staff and patients. Priorities may also be dictated by legal requirements or leadership initiatives.

Tools and resources

Guidance | HCWH high-priority product category list (see annex 4) in sustainable procurement in health care guide

Guidance | HCWH Sustainable procurement: Setting priorities tool (see annex 3) in sustainable procurement in health care guide

Guidance | Stockholm County Council Phase-out list for chemicals hazardous to the environment and human health in products (2017)

Training syllabus | SAICM, KEMI Chemical safety, substitution, and management training for Health Workers

Create a baseline: Conduct an audit

Once priorities have been identified, a baseline assessment is important to understand current purchasing patterns and practices and have information against which to measure progress. Conducting a baseline audit is easier to complete if each audit is restricted to a limited set of similar product categories. You can start by reviewing purchasing records to determine the current inventory of products and conducting a facility audit to identify other products and practices in use throughout the facility.

Assessments help identify variations in the way products are purchased and opportunities for standardization and reduction or elimination. Conduct a walk-through survey to measure against your records, get a better sense of where products are being stored and used, and identify products purchased outside of established purchasing practices. Add these products to the inventory. Try to determine where products purchased outside of regular purchasing practices are coming from and why. You may want to record the following information for each product purchased or found during the walkthrough:

- Product name
- Location and use of the product
- Storage conditions and expiration dates (for durable items)
- Manufacturer, vendor, and/or distributor information
- Safety or instruction sheets, material safety data sheets, and/or label warning language
- Special handling and disposal requirements or personal protective equipment requirements
- Optional: Product cost (to be used later when comparing alternatives)

Identify any products that have been linked to worker injuries or staff or patient complaints. Also determine whether specific products have been implicated in any regulatory compliance issues. Note areas where unapproved items are being used or unusual quantities are found.

Tools and resources

Guidance | HCWH Sustainable procurement in health care guide

Pilot alternatives

Researching and piloting alternatives is a critical step before implementing any changes throughout your facility. When introducing a new product, service, or practice, it is important to pilot the product or process change in order to identify any potential problems, barriers, or unintended consequences. A pilot should be conducted on a small scale, with results measured after a designated time. People responsible for implementing or using the new product or process should be surveyed to determine any potential problems. Once a pilot has been assessed, adjustments or improvements should be made before implementing the change system-wide.

For many alternatives, effective communication, training, and education programs will be important to the success of the change. The more people who understand the reasons for the change, the easier the shift in culture will be, and the more successful the intervention. Facilities can take this opportunity to improve general training and awareness.

Tools and resources

Guidance | HCWH Sustainable procurement in health care guide (p. 34)

Measure progress and celebrate success

Once a plan has been established and goals identified, it is important to establish metrics to track and monitor progress. This will allow you to celebrate success and identify areas in need of additional communication, training, or modification. Measuring progress can be done in a number of ways, such as tracking purchases of targeted products and comparing them with baseline; arranging for periodic inspection rounds to verify improvements throughout the facility; and surveying users.

Staff surveys allow the working group to learn more about what is going well with your initiative and areas of needed improvement. It will also help identify training needs for each area or activity. Training workshops are also useful for monitoring compliance with procedures and identifying new areas for action.

Tools and resources

Guidance | HCWH Sustainable procurement in health care guide

About Health Care Without Harm

Health Care Without Harm works to transform health care worldwide so that it reduces its environmental footprint and becomes a community anchor for sustainability and a leader in the global movement for environmental health and justice.

Health Care Without Harm's vision is that health care mobilizes its ethical, economic and political influence to create an ecologically sustainable, equitable and healthy world.

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