




**Toxic Soup:**  
Is Your Facility a Petrie Dish?



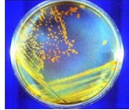




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**Chemical Hazards** in the  
Healthcare Environment

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**Introductions**



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**We Live in a “Bio Chemical Society”**



- In today's world “modern” is often associated with new technology - which can often be harmful to humans and the planet.
- Chemicals of all kinds are in our homes, workplaces, schools, places of worship and hospitals.
- It is present in the clothes we wear, air we breathe and in the food we eat.
- Limited Hazard Information Available
- Many of the common chemicals used today are now being associated with adverse health effects
- What is being done to mitigate the chemicals?


*“We know that 80 percent of the infections you get are transmitted through the environment,”*

Dr. Charles Gerba, a microbiologist at the University of Arizona



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**Learning Objectives**



1. Identify **chemical hazards** that exist in the everyday healthcare setting and the risks these chemicals pose to staff and patients.
2. Infection control vs. Sustainability: The winners and the losers in a **healthcare environment**.
3. Identify ways to implement **alternative strategies** that are environmentally friendly and safe for staff and patients.

*“The sun, the moon and the stars would have disappeared long ago... had they happened to be within the reach of predatory human hands.”*

Havelock Ellis, The Dance of Life, 1923



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**We Live in a “Bio Chemical Society”**




- Many people believe that if products are available for purchase then they must have been tested and, therefore, are safe.
- There are **NO** laws or requirements for testing of adverse health effects from exposure to many of these chemicals.
- There is **NO** law or requirement to list ingredients in products.
- Manufacturers are **ONLY** required to label that products are poisonous or hazardous.
- Most chemicals used today were not available just 70 years ago.



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### Common Toxins In A Healthcare Interior Environment

- Chemicals from medical equipment & supplies
- Heavy metals from upholstery fabrics, leather, paints, dyes and coatings
- Off gassing of interior finishes, building materials and furniture
- Ozone gases from copier equipment
- Airborne germs, bacteria and particulates
- Pest control and cleaning products



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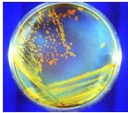
### Biomonitoring Test Performed

Physicians for Social Responsibility (PSR) conducted the first **biomonitoring** investigation of health care professionals.

12 doctors and 8 nurses (from across the country) agreed to have their blood tested for the presence of chemicals in their system. Their blood and urine was tested for 6 chemicals or chemical groups, a total of 62. These chemicals were:

- Bisphenol A (BPA)
- Mercury
- Perfluorinated compounds (PFC's)
- Phthalates
- Polybrominated diphenyl (PBDE's)
- Triclosan

*Biomonitoring is the laboratory analysis of blood, urine, serum, saliva, and other body fluids to identify the burden of certain chemicals present in the human body.*



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According to a 2002 report by **CNN** the **University of Arizona** conducted a study on common germs in a typical office environment

- A desktop has more germs than a toilet seat, over **21,000** germs per square inch.
- Telephone receivers had **25,127** germs per square inch
- Keyboards had **3,295** germs per square inch with another **1,676** on the mouse
- Public magazines in a waiting room are loaded with the germs. Flu and cold viruses survive on dry surfaces up to 48 hours and E Coli can survive on dry surfaces for many months.
- The public water fountain spigot can have **2.7** million germs per square inch on some water spigots as tested by the Public health organization NSF International.

*"Chronic diseases linked to hazardous chemicals are on the rise – including certain cancers, birth defects, learning disabilities, fertility problems, autism and asthma. Total annual costs of environmentally attributable diseases in American children are estimated at \$55 billion."*


(Landrigan, P., 2002, EHP volume 110, number 7)



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### The Results


- Each participant had at least **24 individual chemicals** in their body
- 2 participants had a high of **39 chemicals** detected
- **18 chemicals** were detected in every participant
- **All 20** participants had at least **5** of the **6** kinds of chemicals that were tested and 13 of the participants had all 6.
- All participants had **bisphenol A**, and some form of **phthalates, PBDE's** and **PFC's**.
- **13** participants had **dimethyl phthalate metabolites**, with **9** above the CDC's 95<sup>th</sup> percentile



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### Chemicals or Toxins of Concern

1. **PBT'S** (Persistent Bioaccumulative Toxic Substances )
2. **PVC** (Polyvinyl Chlorine) plastics/vinyl
3. **PFC's** (Perfluorinated compounds) textile coating/additive
4. **HFR'S** (Halogenated Flame Retardants) flame retardants in products
5. **VOC'S** (Volatile Organic Compounds) Formaldehydes, Aldehydes, Acetone; Benzene; Ethylene glycol
6. **Glutaraldehyde** (disinfectant cleaning agent)
7. **Phthalates** (softener used in plastics and fragrance in cleaning agents)
8. **Heavy Metals** (Chromium, Arsenic, Cadmium, Lead, Mercury, and Manganese) upholstery fabrics, leather, coatings



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### HEAVY Metals

The most common heavy metal toxins are:

- Aluminum
- Arsenic
- Cadmium
- Lead
- Mercury

*"Because we don't think about future generations, they will never forget us."*

*Henrik Tikkanen*



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### Volatile Organic Compounds VOC's

Examples of problematic VOCs are:

- **Formaldehyde**
- **Benzene**
- **Toluene**
- **Xylene**
- **Acetaldehyde**
- **Isocyanates**

These chemicals are commonly found in:

Furniture, paint, stains, millwork substrates, insulation, glues, flooring, mattresses, cleaning products, bedding and pillows.



*"Action is the foundational key to all success."*  
Pablo Picasso


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### Phthalates

Three **phthalates** (BBP, DEHP and DBP) - hormone-disrupting reproductive toxicants used in many flexible PVC products such as vinyl flooring, textiles and wall coverings

**HBCDD** - a persistent bioaccumulative toxicant (PBT) widely used as a flame retardant in polystyrene foam insulation

**MDA** - a known potent carcinogen used as a basic building block in the manufacture of polyurethane foams and MDI composite wood binders



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### Perfluorinated Compounds (PFCs) PFC Family: PTFE, PFOS, PFOA


Perfluorinated chemicals are persistent, bioaccumulative toxicants (PBTs).

PFOS is considered **unusually persistent**, unable to breakdown under any known conditions, thus remaining in our environment forever, posing threats of ongoing exposure and toxicity to humans and wildlife.

PFCs are widely used to create high performance materials, create water and soil repellency in textiles.

Common Products that contain PFC's:

1. Crypton	6. GreenShield
2. Crypton Green	7. Gore
3. Teflon	8. Scotchguard (which ceased production in 2003)
4. Stainmaster	
5. NanoTex	



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### Polyvinyl Chloride (PVC)

PVC is found in:

- Flooring
- Ceiling tiles
- Coatings
- Carpet backing
- Pipes and conduit
- Window treatments
- Furniture
- Fabrics & Upholstery
- Wall and corner guards
- Wiring and cable sheathing
- Wall covering
- Children's products/toys
- Medical tubing and supplies

*"PVC is the most toxic plastic for our health and environment. No other plastic contains or releases as many dangerous chemicals. Unfortunately the poison plastic is widespread in schools across the nation"*

CHEJ



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### Halogenated Organic Flame Retardants (HFRs) HFR Family: BFR's, PBOE's, CFR's

Halogenated flame retardants **DO NOT** break down easily in the environment.

HFRs are widely used as a flame retardant chemical.

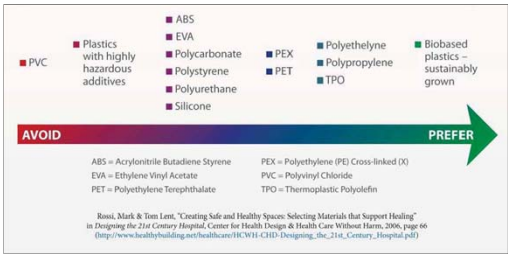
Products that contain HFR's:

1. Upholstery	9. Electronic equipment
2. Draperies	Computers
3. Bedspreads	10. TV's
4. Cubicle Curtains	11. AV equipment
5. Mattresses	12. Printers
6. Mattress pads	13. Patient Monitoring
7. Pillows	Devices
8. Wallcoverings	



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### Plastics: Environmental Preference Spectrum



**AVOID** ← **PREFER**

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

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


Rossi, Mark & Tom Lent, "Creating Safe and Healthy Spaces: Selecting Materials that Support Healing" in *Designing the 21st Century Hospital*, Center for Health Design & Health Care Without Harm, 2006, page 66 ([http://www.healthybuildings.org/healthcare/HCW11-CHD-Designing\\_the\\_21st\\_Century\\_Hospital.pdf](http://www.healthybuildings.org/healthcare/HCW11-CHD-Designing_the_21st_Century_Hospital.pdf))

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### PVC (Polyvinyl Chloride) & Asthma

- Asthma affects **7 million American children** and **16 million adults**.
- Asthma is a **leading cause of school absenteeism**: 14.7 million school days are missed each year due to asthma.
- Studies have found a correlation between **phthalates** emitted from **PVC building products** and **asthma**
- A study published in 2009 found a statistically **significant link** between **PVC flooring** and **asthma**.


*"Chronic diseases linked to hazardous chemicals are on the rise – including certain cancers, birth defects, learning disabilities, fertility problems, autism and asthma. Total annual costs of environmentally attributable diseases in American children are estimated at \$55 billion."*  
(Landrigan, P., 2002, EHP volume 110, number 7)



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### Sources of Toxins in a Hospital: Building Material & Sites Related Issues

- Vinyl Flooring/Base/Wall Protection
- Vinyl Wallcoverings
- Paints and adhesives
- Insulation
- Door handles/elevator buttons
- PVC
- Cubical curtains
- CO2 from adjacent parking garages
- Food service
- Packing material



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### Toxins in a Hospital Come From a Variety of Sources


- Hand Washing Soaps
- Building Cleaning Products/Pesticides
- Building Materials, Site Related Issues & Furniture
- Medical Supplies
- Equipment
- Airborne
- IV tubes
- Latex gloves
- Fluorescent bulbs



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### Sources of Toxins in a Hospital: Equipment


- Copy Machines
- Computer monitors
- Keyboards and computer mouse
- PVC in computer cables
- Coffee machines
- Phones
- X-Ray equipment
- Vending machines



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### Sources of Toxins in a Hospital: Hand Washing, Building Cleaning Products & Pesticides

- Glass cleaners
- Bleach
- Antimicrobial soap
- Antimicrobial hand cleaner
- Floor striper
- Acrylic wax
- Pesticides



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### Sources of Toxins in a Hospital: Furniture, Fabrics & Upholstery

Furniture

- PVC: Table edge details
- VOC's in Table and Desk/Workstation Substrates
- VOC's in Adhesives, Paint Finishes, Wood Finishes & Coatings

Fabric & Upholstery

- Fabric Dyes
- Flame Retardant Treatments
- Stain Treatments
- Leather Dyes & Finishes (Heavy Metals)




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### Sources of Toxins in a Hospital:

Disinfectants commonly used in hospitals are **ammonia compounds, phenols** and **bleach** are registered by the EPA as **pesticides**.

Health affects from long term exposure to ammonia are occupational asthma and hypersensitivity syndrome.




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### Hospital Acquired Infections: The Financial Impact

- HAI's account for **\$47 billion** in added health care costs in the U.S.
- A CDC study estimates that HAI's add 208% to hospital bills.
- HAI's result in 29.8% readmissions, vs. 6.2% readmissions where no HAI was present.
- Estimated Medicare costs for readmission exceeds \$24.6 million annually.
- Medicare/Medicaid no longer cover the cost for preventable conditions, like HAIs and medical errors.**

*"Intelligence without ambition is a bird without wings"*  
Salvador Dalí



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### Infection Control in the Healthcare Environment






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### Hospital Acquired Infections: Types of Infections

- Surgical Site Infections: Highest readmission rates within 30 days at 53.6%.
- Central Line Infections: Account for 15% of all HAIs and 30% of HAI related deaths.
- VRE or Vancomycin-Resistant Enterococcus: Causes sepsis, pneumonia, and endocarditis
- MRSA
- Intestinal Tract Infections: Clostridium or C- Difficile

*"The only way to keep your health is to eat what you don't want, drink what you don't like, and do what you'd rather not."*  
Mark Twain




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### Hospital Acquired Infections: The Facts

- 90,000 to 100,000** patients **die every year** from HAI's in the U.S. This is a 1 in 20 chance of dying if you acquire an HAI.
- Kills more people than auto accidents, fires and drowning.
- Causes more deaths annually than breast cancer and HIV combined.
- 4<sup>th</sup> leading cause of death** in the U.S. behind heart disease, cancer and stroke.

*"A man's health can be judged by which he takes two at a time - pills or stairs."*  
Joan Welch




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### Hospital Acquired Infections: Sources of Transmission

- Number **one** method of transmission: **Hands of healthcare workers**
- Other methods of transmission:
  - Poor cleaning practices - Inadequate cleaning of patient room/bathroom between patients
  - Clothing & shoes of healthcare workers & visitors
  - Airborne (Sneezing and Coughing)

*"As the poet said, 'Only God can make a tree,' probably because it's so hard to figure out how to get the bark on."*  
Woody Allen




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## Hospital Acquired Infections: Sources of Transmission

Hands of healthcare workers:  
What do they **touch**?

- Keyboards
- Leading Edge of Cubicle curtains
- Hospital Bed Rails
- Patient IVs, bandages, etc.
- Chair Arms
- Patient Monitors
- Overbed Tables
- Bathroom surfaces
- Light switches
- Door handles

*"A man's health can be judged by which he takes two at a time - pills or stairs."*  
Joan Welch



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## Movements to Promote Good Infection Control Practices: **Evidence-Based Design**

- **Evidence-based design** is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes. (Center for Health Design,2011)
- The Center for Health Design ([www.healthdesign.org](http://www.healthdesign.org))
- EDAC certification
- The Pebble Partner Project

*"He who loves practice without theory is like the sailor who boards a ship without a rudder and compass and never knows where he may cast."*  
Leonardo da Vinci



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**"The patient in the next bed is highly infectious. Thank God for these curtains."**

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## Evidence-Based Design

**Evidence-based design** is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes. (Center for Health Design,2011)

Infection Control Prevention Strategies:

- Single Patient Rooms
- Alternative Design Strategies
- Silver Ion Technology
- Copper
- Anti-microbial Nanotechnology
- UV-PCO (ultra-violet photo catalytic oxidation)

*"Action is the foundational key to all success."*  
Pablo Picasso



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## Alternative Strategies for Sustainable Infection Control Practices






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## Alternative Design Strategies: **Passive Infection Control**

- Single Patient Rooms
- Cubicle curtain-free design
- Elimination of dust shelves
- Number and placement of hand washing sinks
- Cleanable keyboards
- Overbed tables with split surface design
- Slanted tops on upper cabinets and lockers
- Seamless floors
- Integral cove or coved base
- Motion-activated Devices
- Window treatments: solar shades or integral blinds
- No reveals in millwork & headwall design
- Solid surface counter tops with integral bowl sinks

*"Be careful about reading health books. You may die of a misprint."*  
Mark Twain



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### Alternative Design Strategies: Metals

Both Copper and Silver use the same approach:

The ions bind with the bacteria and damage their cells in a number of ways, disrupting their normal function, stopping them from reproducing and causing them to die.

*"Often the hands will solve a mystery that the intellect has struggled with in vain."*  
Carl Jung




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### Alternative Design Strategies: Copper

- Copper is a broad spectrum antimicrobial which kills bacteria, fungi and viruses including MRSA, E. Coli, C-Difficile and Influenza A (H1N1).
- Copper and copper alloys are the only solid surfaces to be registered by the US EPA as antimicrobial.
- The Copper Development Association is working with manufacturers to incorporate copper into healthcare touch-surface products.
- Application of copper to common surfaces in a patient room results in a 90% reduction in microbes.

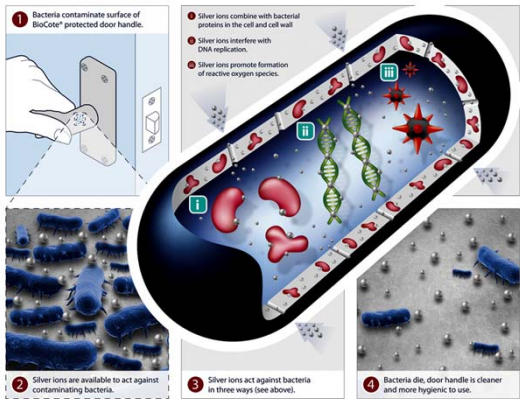
*"To see the world in a grain of sand, and to see heaven in a wild flower, hold infinity in the palm of your hands, and eternity in an hour."*  
William Blake



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### Alternative Design Strategies: Anti-Microbial Nanotechnology

How Does It Work?



*"It is health that is real wealth and not pieces of gold and silver."*  
Mahandas Gandhi

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### Alternative Design Strategies: Silver Ion Technology

- Silver was recognized in ancient Greece and Rome for its infection-fighting properties.
- Used in a wide range of medical products, such as wound dressings and catheters, reducing HAIs.
- Silver can be added to everyday products at the manufacturing stage, without affecting performance or aesthetics.
- Ideal antimicrobial agent due to its effectiveness against a wide range of microorganisms
- Non-toxic to non-target cells.

*"Often the hands will solve a mystery that the intellect has struggled with in vain."*  
Carl Jung




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### Alternative Design Strategies: UV Disinfection Technology

- Alternative Way to Disinfect Patient Rooms: October 2010 study at UNC Chapel Hill concluded that using UV Device in a patient room for 15 minutes resulted in a 99.8% decrease in MRSA, VRE, and C-Difficile.
- Can be used to disinfect HVAC duct systems and water treatment systems.
- Good supportive technology for disinfection, but not a stand-alone method.

*"The devil has put a penalty on all things we enjoy in life. Either we suffer in health or we suffer in soul or we get fat."*  
Albert Einstein



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### Sustainable Ways to Mitigate Toxicity

#### Alternative Building Materials

- Nanocoatings
  - Building Insulation
  - Air and Water Filtration
  - Self Cleaning Windows & Tiles
  - Adhesives, Grouts and Coatings
  - Smog Eating Concrete
- Active Clean Tile –100% Bacteria Reduction (*GranitiFiandre*)
- Clean Vinyl Wallcovering (*Len-Tex*)
- Ceiling tile that absorbs formaldehyde & aldehydes from indoor air (*Armstrong*)
- Copper door hardware
- PVC free electrical components
- PVC free wallcovering
- Low VOC free paint with “Microban”
- PVC Free Biobased Resilient Flooring (*Armstrong*)




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### Sustainable Ways to Mitigate Toxicity

#### Alternative Office Equipment

- Low VOC Computer & Printer Equipment – *Greenguard, Blue Angel*
- Elimination of BFR’s, Mercury & PVC in Computer Equipment (*Brominated Flame Retardants*)
- Washable Keyboard Trays (*Medisafe*)

“Computer keyboards are so dirty they could cause symptoms of food poisoning and other illnesses,” *Which?*



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### Sustainable Ways to Mitigate Toxicity

#### Alternative Building Materials

- UV protection
- Low Mercury Fluorescent Linear Lamps
- Heat Absorbing Films (*3M*)
- Copper door hardware
- “Silverban” Antimicrobial Wood Finish (*Euraluxe*)
- Linoleum – Naturally Antimicrobial (*Forbo, Armstrong, Johnsonite*)
- Intersept Antimicrobial Backing on Carpet Tiles (*Interface*)
- Mold Resistant Plaster (*American Clay Earth*)
- Antimicrobial Treatment on Carpet Tiles (*Milliken*)
- Solid Surface Quartz Counters with Antimicrobial (*Silestone*)



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### Ways to Migrate Toxicity

#### Alternative Cleaning Products & Practices

- Vacuums with HEPA Filters – reduce airborne particulates
- Microfiber Cleaning Cloths
- Soaps with No Phosphates
- Non-Antibacterial Soap
- Electrostatic Carpet Cleaners



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### Sustainable Ways to Mitigate Toxicity

#### Alternative Furniture Finishes & Furnishings

- “Silverban” Antimicrobial Wood Finish (*Euraluxe*)
- PVC Wall Protection & Bumpers (*Boston Retail*)
- PVC Free Worksurface Edges (*Herman Miller/Knoll*)
- Urethane Worksurface Edges (*Izzy Design/Knoll*)
- Linoleum – Naturally Antimicrobial (*Forbo, Armstrong, Johnsonite*)
- Cubicle Curtains with Anti-Microbial Treatments (*Maharam, Momentum, Koraseal*)
- Formaldehyde Free Mattresses
- CFC, HCFC & Formaldehyde Free Upholstery Foam
- Indoor Plants – Naturally Absorb CO2 & VOC’s



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### Sustainable Resources



- LEED For Healthcare (HC) [www.usgbc.org](http://www.usgbc.org)
- Green Guide for Healthcare [www.gghc.org](http://www.gghc.org)
- Pharos Project [www.pharosproject.net](http://www.pharosproject.net)
- CHEI – Center for Health Environment & Justice [www.chei.org](http://www.chei.org)
- Greenguard [www.greenguard.org](http://www.greenguard.org)
- CRI (Carpet and Rug Institute) [www.carpet-rug.org](http://www.carpet-rug.org)
- Green Seal [www.greenseal.com](http://www.greenseal.com)
- Building Green [www.buildinggreen.com](http://www.buildinggreen.com)
- EPA (Environmental Protection Agency) [www.epa.gov](http://www.epa.gov)
- CDC (Center For Disease Control) [www.cdc.gov](http://www.cdc.gov)
- Healthcare Without Harm [www.noharm.org](http://www.noharm.org)
- Healthy Building Network [www.healthybuilding.net](http://www.healthybuilding.net)
- Beyond Pesticides [www.beyondpesticides.org](http://www.beyondpesticides.org)
- EPEAT [www.epeat.net](http://www.epeat.net)
- ACT (Association for Contract Textiles) [www.contracttextiles.org](http://www.contracttextiles.org)
- MBDC Cradle to Cradle [www.mbdc.org](http://www.mbdc.org)



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“No evidence is available to suggest that use of these [antimicrobial] products will make consumers and patients healthier or prevent disease. **No data support** the use of these items as part of a sound infection-control strategy.”  
2003 CDC Comprehensive Study of Infection

“[w]e **do not** recommend environmental surface finishes or fabrics that contain **antimicrobials** for the purpose of greater infection control and the subsequent prevention of hospital acquired infections.”  
Kaiser Permanente



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Questions



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Thank you!



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