The greening of healthcare: fabrics used in healthcare facilities

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Introduction

Factors that influence the healthcare environment such as air quality, temperature control and infection control have been generally well addressed.

What about less obvious environmental exposures to fabrics? We wear clothing and naturally tend to take fabric for granted.

It has been only in the last 18 years or so that there has been a structured attempt to control the quality of healthcare construction and its contents, including fabric.

The "greening" of healthcare textiles is thus a topic of great importance due to the large number of chemicals used in production and maintenance, and hence exposure to both patients and all healthcare workers in the form of dermal contact, inhalation, and ingestion.

Criteria Framework

Leadership in Energy and Environmental Design (LEED) is a comprehensive internationally recognized standard for certification and construction of green buildings. The principles that apply specifically to textile selection are the following 5 criteria:

- Local Source Availability
- Durability
- Sustainability
- Recyclability
- Surface Finishes & Cleanability

Table 1. Green Selection – 5 Criteria

Third Party Certification

While textile certification can be provided by governments and by industry, we contend third party certification is the optimum route to provide unbiased certification information on chemical toxicity and exposure risks of commercial and healthcare fabrics. These third party organizations include:

- Leadership in Energy & Environmental Design (LEED)
- McDonough Braungart Design Chemistry (MBDC)
- Öeko-tex
- Greenguard Environmental Institute (GEI)
- Scientific Certification Systems (SCS)
- Global Organic Textile Standard (GOTS)
- American Society of Testing & Materials (ASTM)

Textile Chemicals of Concern

Chemical	Toxicity	Agency
Formaldehyde	Gr 1 - Carcinogenic to humans List of toxic substances	$IARC_6$ $CEPA_3$
Volatile Organic Compounds (VOCs)	List of toxic substances	$CEPA_3$
Phthalates	Inconclusive as to estrogenicity	CDC_2
Di(2-ethylhexyl)phthalate	Reasonably anticipated to be human carcinogen	$ATSDR_1$
Quaternary Ammonium Compounds	contact dermatitis; broncho-constriction if prone to asthma Quats release formaldehyde	$PIMS_7$ EHA_4
Vinyl Chloride	Human carcinogen List of toxic substances	$ATSDR_1$ $CEPA_3$
Polyurethane	Gr 3 - not classifiable as carcinogen	$IARC_6$
Toluene diisocyanate	Gr 2B - possibly carcinogenic to humans Animal carcinogen	$IARC_6$ $PIMS_7$
Antimony trioxide	Gr 2B - possibly carcinogenic to humans Toxic substance	$IARC_6$ $ATSDR_1$
Perfluorooctanoic acid (PFOA)	Likely to be carcinogenic to humans	EPA_5
Polybrominated diphenyl ethers (PBDEs)	List of toxic substances Bioaccumulative, biomagnification Evidence of thyroid & endocrine disruption	$CEPA_3$ $CEPA_3$ $ATSDR_1$
Decabrominated diphenyl ether	Limited evidence for animal carcinogenicity	$ATSDR_1$
Triclosan	Inconclusive toxicity	CDC_2
Agency		
$ATSDR_1$ – U.S. CDC's Agency for Toxic Substance & Disease Registry CDC_2 – U.S. Center for Disease Control $CEPA_3$ – Environment Canada's Canadian Environmental Protection Agency EHA_4 – Canada's Nova Scotia's Environmental Health Association EPA_5 – U.S. Environmental Protection Agency $IARC_6$ – World Health Organization's International Agency for Research on Cancer $PIMS_7$ – International Programme on Chemical Safety Poisons Information Monograph		

Table 2. Textile Chemicals of Concern

Description

The pyramid represents the most toxic fabric at the peak descending to less toxic alternatives at the base. Polyvinyl chloride (PVC) contains vinyl chloride. Phthalates make PVC vinyl fabric flexible. Some manufacturers are substituting less toxic polyurethane as an alternative, however, polyurethane does contain toluene diisocyanate. Polyester (polyethylene terephthalate) may be manufactured from recycled plastic water or pop bottles and it is possible to make it without antimony trioxide. A newer polyester , polybutylene terephthalate has a better toxicity profile for healthcare fabrics. Of the two olefins, polyethylene and polypropylene, polyethylene has better features for healthcare use. Bio-based polymers such as corn, silicone and soybeans are being introduced primarily in blends with petroleum based synthetics to lower non-renewable content. The benefit of this is debatable when the entire lifecycle analysis is considered. Rayon and bamboo may have limited use for healthcare due to cleanability.

For natural fibres, cotton has the best performance for healthcare. Considering its high use of water and chemicals for production, certified organic cotton is the preferable choice. Non-organic cotton may have formaldehyde used as a soil-releasing stain-resistant finish.

Stain-repellent finishes with perfluorooctanoic acid (PFOA) and flame retardant finishes with polybrominated diphenyl ethers (PBDEs) are to be avoided in favour of fabrics with characteristics inherent. Some fabric dyes off-gas volatile organic compounds (VOCs). The benefits of triclosan as an antibacterial are inconclusive. Cleaning products that contain quaternary ammonium compounds which release formaldehyde are to be avoided in favour of acetic acid, hydrogen peroxide and hot temperatures.

Pyramid of Plastics

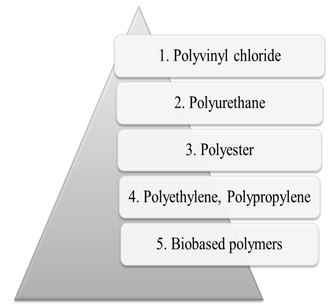

Figure 1. Greenpeace Pyramid of Plastics

Conclusions

Healthcare textiles in current use may pose a serious risk to the health and safety of patients and all healthcare workers, when they are unknowingly exposed to the chemicals of concern. Many studies have been done on acute or chronic exposure of large doses of these chemicals and toxicity profiles have been identified. However it is difficult to assess the risk of exposure of these chemicals at low doses, over a long period of time, or consider the risk on patients who are already immuno-compromised.

Governments appear to side with scientifically 'proven' hazards rather than risk the liability of banning a product that is only potentially harmful. Their approach is to work with manufacturers for voluntary discontinuation over a period of time. Environmental groups appear to be at the other extreme of demanding immediate bans.

The middle ground suggests the advisability of selecting textiles that have third party certifications applicable to textiles. Decisions based on the criteria of sourcing locally, selecting durability, using credible standards of performance, selecting sustainable natural fibres, recycled or recyclable synthetic fibres, selecting minimal topical finishes, and selecting fabrics with ease of cleanability are advised for the greening of healthcare fabrics, and hence improving the quality of the healthcare environment.

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