

**Background:**

Hospitals are institutions dedicated to providing healthcare. However, some hospital practices may pose health risks. Many hospitals use medical materials made from polyvinyl chloride (PVC). PVC accounts for 40% of chlorine usage in the United States and makes up more than 80% of chlorinated medical waste (Thornton, 2000). Many PVC medical products contain a plasticizer called Di(2-ethyl-hexyl)phthalate (DEHP) to make the plastic flexible (Health Care Without Harm [HCWH], 2002). In addition, PVC production and incineration releases the chemical dioxin into the atmosphere, affecting public air quality and health. The health effects of exposure to DEHP and dioxin merit further investigation of their use in hospitals.

***PolyVinyl Chloride (PVC)-containing medical devices:***

Intravenous (IV) bags  
IV tubing  
Catheters  
Nasal cannulas  
Aphaeresis circuits  
Suction catheters  
Resuscitation bags  
Urinary collection devices  
Wound drainage devices

**Hypothesis:**

Hospital usage of PVC medical products contributes significantly to the detriment of patient and public health.

**Methods:**

A literature review was conducted to analyze data of PVC medical devices and their possible effects on humans.

**Results:**

***Dioxin:*** Dioxin is a lipophilic chemical that bioaccumulates in fatty tissue. In the year 2000, medical waste incineration was the second largest contributor to the emission of dioxin (Environmental Protection Agency [EPA], 2005). The general public is exposed to excessive levels of dioxin daily through inhalation of emissions and consumption of contaminated animal or plant materials. A preliminary review and analysis of human epidemiological data, including follow-up and case-controlled studies, revealed a general increased risk of overall cancer due to the exposure to dioxin (EPA, 2005).

**Cancers:**

- Bone
- Breast
- Connective and soft tissue
- Genitourinary
- Hodgkin's disease
- Non-Hodgkin's lymphoma
- Liver

- Lung
- Myeloid leukemia
- Multiple myeloma
- Stomach
- Multiple system cancers

**Non-cancerous disorders:**

- Chloracne (severe acneform) (S)
- Hirsutism (S)
- Porphyria (S)
- Decreased testosterone levels (S)
- Increased GGT levels (S)
- Respiratory irritation (S)
- Hyperlipidemia (M)
- Altered glucose metabolism (M)
- Endometriosis (M)
- Peripheral neuropathy (M)
- Transient hepatomegaly (M)
- Hyperpigmentation
- Hypomania
- Miscarriage
- Birth defects (C)
- Hypomineralization of permanent molars (C)

**DEHP:** A Center for Disease Control study reveals that general public exposure to phthalates (the chemical category of DEHP) is near to or above regulatory levels for the developing male reproductive toxicity endpoint (HCWH, 2002). In addition, approximately 2 million women of reproductive age are exposed to 75% the tolerable intake level of DEHP daily (HCWH). Most concerning is the high risk of DEHP absorption from intravenous medical procedures. DEHP leaches into intravenous solutions and is absorbed by the blood stream. Due to the lipophilic chemical property of DEHP, patients receiving high-lipid containing solutions, such as total parental nutrition and blood transfusions, are at greater risk of absorbing DEHP. For example, neonates who receive a single blood transfusion have shown extremely high systemic levels of phthalates (Thornton, 2000). Exposure level to DEHP is correlated to health prognosis. Those who are exposed to higher levels of DEHP are at greater risk of developing health problems associated with DEHP (Thornton). Therefore, patients who absorb higher levels of DEHP are more likely to develop these health problems.

*Human Exposure (HCWH, 2002)*

- Liver, reproductive, and respiratory cancer
- Cholestasis
- Increased liver enzyme levels
- White blood cell abnormalities

*Mammalian Exposure (HCWH; TEACH database, 2007)*

- Liver abnormalities
- Decreased fertility
- Hypospadias

- Reduced testicular weight
- Decreased sperm production
- Decreased testosterone levels
- Increased follicle stimulating hormone levels
- Anemia
- Liver cancer
- Endometriosis
- Skeletal malformations

Cleft palate

### **Conclusion:**

Exposure to dioxin is known to cause multiple cancerous and non-cancerous disorders. Current hospital practice of incinerating medical waste, which contains PVC, is the second largest contributor to dioxin emissions. In addition, the manufacture of PVC emits dioxin. Therefore, the usage of PVC in the hospital and its consequent incineration places the general population at risk of exposure to dioxin. Hospital usage of PVC medical products increases the public's risk of cancer and other serious disorders correlated with dioxin exposure.

In addition, DEHP leaches from plasticized products into intravenous (IV) fluids to be absorbed by patients. IV medical procedures increase the risk of direct patient absorption of DEHP. Therefore, seriously ill patients need more intravenous medical procedures, such as those who require dialysis or extracorporeal membrane oxygenation, are at risk of higher DEHP absorption levels. Higher levels of DEHP absorption are correlated with a greater risk of developing DEHP-related diseases, such as cancer and hormone disruption. Hospitals are placing the sickest patients at the greatest risk of harm.

Hospitals are institutions devoted to patient care; it is unacceptable for them to contribute to atmospheric emissions of dioxin, a known carcinogen. In addition, hospitals place patients at risk of developing cancer and other disorders by using DEHP-plasticized medical products. This practice places the sickest of the sick at the greatest risk for developing these disorders. Hospitals should reduce or eliminate the use of PVC products and DEHP-plasticized products in order to improve patient and public health.

### **Recommendations:**

- Hospitals should seek alternatives to PVC and DEHP containing medical products. Alternative products include:
  - PVC: silicone, poly-ethylene, polypropylene
  - DEHP: citrate, adipates, and trimellitates (Thornton, 2000)
- More case studies of health risks associated with human exposure to DEHP should be conducted to validate current data.
- More studies of health risks associated with rhesus monkey exposure to DEHP should be conducted to validate current data.

**Limitations:**

An initial hypothesis theorized financial benefits of eliminating PVC-products from hospitals, however US economic studies of purchasing patterns were unavailable. Data available from pharmaceutical companies are not available to the general public and are inaccurate at best when considering economics of scale and cost-reduction to larger orders. Additionally, data available from foreign countries do not apply to US hospitals due to increased availability of PVC-free products. Therefore, a cost-effectiveness analysis of PVC versus PVC-free medical products was eliminated from this study. Further limitations included lack of studies of health effects from human exposure to DEHP. Mammalian research does provide an insight to possible human outcomes from DEHP exposure, but most research is performed on rats or mice. More research is needed on rhesus monkeys, the most genetically similar species to humans, and prospective studies of accidental human exposure.

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