DEHP: Concerns and Alternatives

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Tetra Tech EM Inc.
Take Home Message

1. Increasing Medical Concerns - FDA Advisory: Minimize DEHP products in high-risk patient populations.

2. Tackle High-Risk Areas & Align Your Focus and Influence.

3. Alternatives Are Readily Available.

4. $$ - Additional Cost Is Relatively Low: ~10-20% more, <$20/patient/day
The Larger Issue...PVC

- Most widely used plastic in medical products
  - Cost
  - Flexibility
  - Transparency
  - Resistance to breakage
- 27% of all plastic used in 1996
- The only common plastic that is chlorinated
- DEHP (di-ethylhexyl phthalate) often used as a plasticizer in medical devices
**DEHP**

di (2-ethylhexyl) phthalate

- Migrates from PVC when in contact with fluids, air, or heat
- Lipophilic

Leaching increases with...
- Temperature
- Contact (storage time)
- Amount of fluid
- Agitation
- Lipid content
Increasing Medical Concerns

- Reproductive & developmental toxicant
- Infertility, hypospadias spectrum, premature thelarche
- Targets Sertoli cells of the testes
- Liver and pulmonary effects

FDA and NTP issued warnings
Government Warnings

- **October, 2000:** US Department of Health, National Toxicology Program
- **March, 2001:** CA Medical Association Resolution: Eliminate DEHP in Neonatal Intensive Care Units
- **July, 2002:** FDA Public Health Notification
FDA Public Health Notification

Recommends:

- Using alternatives to DEHP-containing products for procedures with excessive exposures
- Reformulation of products to decrease/eliminate DEHP exposures
- Labeling of DEHP-containing products
FDA Safety Assessment

• FDA derived a “tolerable intake” (TI) for DEHP
  - Parenteral: 0.6 mg DEHP/kg/day
  - Oral: 0.04 mg DEHP/kg/day

• TI calculations based on NOAELs and LOAELs from numerous animal studies of testicular toxicity
## DEHP Exposures

<table>
<thead>
<tr>
<th>mg/kg/day</th>
<th>Adult DEHP dose</th>
<th>Adult TI/dose</th>
<th>Neonate DEHP dose</th>
<th>Neonate TI/dose</th>
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<tbody>
<tr>
<td>IV: crystalline</td>
<td>0.005</td>
<td>120</td>
<td>0.03</td>
<td>20</td>
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<td>IV drugs w/vehicles</td>
<td>0.15</td>
<td>4</td>
<td>0.03</td>
<td>20</td>
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<tr>
<td>TPN (lipid)</td>
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<td>5</td>
<td>2.5</td>
<td>0.2</td>
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<tr>
<td>Enteral nutrition</td>
<td>&lt; 1.0</td>
<td></td>
<td>0.14</td>
<td>0.3</td>
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<tr>
<td>ECMO</td>
<td>3.0</td>
<td>0.2</td>
<td>14</td>
<td>0.04</td>
</tr>
<tr>
<td>Exchange Transfusion</td>
<td></td>
<td></td>
<td>22.6</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Focus: High Risk Areas

Early Preterm Infants

- Critically ill patient population
  - IV therapy
  - Parenteral and enteral feedings
  - Ventilation
  - Blood transfusion
- Long hospital stay
  - Prolonged therapies
Survival Rates for Early Preemies
(23 to 26 weeks)

Hoekstra Peds 2004;113:e1
Most Sensitive System:

**Immature Male Reproductive Tract**

- MEHP is the toxic metabolite
- **Mechanism of Action**
  - Decrease testosterone synthesis; interference with Leydig cell differentiation
- **Target Tissues**
  - Sertoli cells
  - Seminiferous tubules, sperm, epididymis, penis, prostate (fetal exposures)

NTP-CERHR-DEHP-00, Oct 2000
Moore, 2001  EHP 109:229; Gray LE, NIEHS presentation
PVC/DEHP-Containing Products

- **Gloves**
  - Exam
  - Surgery

- **Bags**
  - IV
  - Nutrition
  - Blood

- **Tubing**
Gloves

Low risk: not typically invasive or long-contact

1. Latex
2. Nitrile
3. PVC (usually marketed as latex-free)

- Parallel efforts to eliminate latex gloves because of allergies...

...but “latex-free” usually means PVC/DEHP
Gloves - Alternatives

- Use powder-free latex or nitrile
- Examine life cycle costs and performance of PVC gloves

...Tufts/1999 Kaiser Studies:
- Failure Rate:
  - PVC 30%
  - Nitrile/Latex 2%
- Staff use “double-gloving” for extra protection
- Nitrile/Latex gloves are cost competitive
Tubing

High-risk: long contact, conveys air and fluids, some high volume

- PVC less prone to kinking
- Becomes more brittle with use as DEHP leaches
Tubing - Alternatives

- Focus on tubing used to introduce fluids/gases into the patient
- Examine tubing upstream of equipment: e.g., wall to ventilator
IV Bags

High risk: long contact, some lipid fluids, some high volume

- PVC/DEHP-free alternatives available
- Driven by demand
- 3 Vendors: Baxter, Braun, Hospira (Abbot)
IV Bags - Alternatives

- B Braun is the only current supplier of PVC/DEHP-free bags
- PVC bags:
  - Require an “overwrap” to preserve shelf life
  - Are thicker/heavier than alternatives

B Braun DEHP-free bags are cost competitive; 10-20% more expensive
Nutritional Bags - Alternatives

- Market demand exists:
  - Baxter: EVA (no-PVC)
  - Hospira (Abbot): PVC but w/o DEHP
  - Each has about 40% market share

PVC/DEHP-free alternatives are cost competitive
Blood Bags

- Blood Bank Users:
  - Few PVC/DEHP-free bags available/used
  - DEHP used as a preservative

Tackle other areas first; raise awareness among blood banks/public
JMMC DEHP Reduction Plan

1. Establish DEHP reduction policy for NICU
2. Implement reduction plan
   a. Get list of all supplies from Purchasing Dept.
   b. Audit supply room and identify plastics used in “high-risk therapies.”
   c. Purchasing Dept. contacts manufacturers to determine DEHP content
   d. Nursing and respiratory therapy staff evaluate alternative based on clinical applicability and efficacy
   e. Preferred product list sent to Purchasing Dept.
3. Expand program
JMMC Success Factors

• Easily identified “Cause Champion”
• Changes occurred “under the radar”
• Cost not a large factor
• Readily available alternatives for most products

Effort required:
- 40 hours primarily by nursing supervisor over 1 year
Problematic Areas

• Premixed IV solutions
  - Parenteral solutions mixed by pharmacy in non-DEHP bags

• Blood Bank
  - Red Cross blood products uses blood bags containing DEHP
## JMMC Plastic Products

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description</th>
<th>Cat#</th>
<th>DEHP?</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>9906</td>
<td>Long-life feeding Tube</td>
<td>730709</td>
<td>No</td>
<td>Children’s Medical Venture</td>
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<tr>
<td>5420</td>
<td>Dispensing pin with valve</td>
<td>3548441</td>
<td>No</td>
<td>B. Braun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2695</td>
<td>Neonatal catheter</td>
<td>2184-00</td>
<td>No</td>
<td>Vygon</td>
</tr>
<tr>
<td>Item #</td>
<td>Description</td>
<td>Cat#</td>
<td>DEHP?</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------</td>
<td>----------------</td>
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<td>-------------------</td>
</tr>
<tr>
<td>34257</td>
<td>Soluset-Microdrip</td>
<td>00131194802</td>
<td>Yes</td>
<td>Abbott</td>
</tr>
<tr>
<td>1843</td>
<td>Butterfly Inf 19 X 7/8 X 12</td>
<td>001345900101</td>
<td>Yes</td>
<td>Becton Dickinson</td>
</tr>
<tr>
<td>3094</td>
<td>Transducer Transpac</td>
<td>00154256001</td>
<td>Yes</td>
<td>Abbott</td>
</tr>
<tr>
<td>13062</td>
<td>Tray Exchange Transfusion</td>
<td>07055004110</td>
<td>Yes</td>
<td>Pharmaseal Allegiance</td>
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<td>34257</td>
<td>Soluset-Microdrip</td>
<td>19231-12</td>
<td>No</td>
<td>Abbott-new item</td>
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<tr>
<td>1843</td>
<td>Butterfly Inf 19 X 7/8 X 12</td>
<td>001345900101</td>
<td>Yes</td>
<td>Becton Dickinson-use for blood drawing-no risk</td>
</tr>
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<td>48795</td>
<td>Transducer</td>
<td>MX20775</td>
<td>No</td>
<td>Medex-New Item</td>
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<tr>
<td>13062</td>
<td>Tray Exchange Transfusion</td>
<td>07055004110</td>
<td>Yes</td>
<td>Pharmaseal Allegiance-No alternative. No longer used, change in practice</td>
</tr>
</tbody>
</table>
NICU Replacement Summary

• Survey found:
  - 31 plastic items
  - Only 5 contain PVC/DEHP and are used in exposure scenarios
  - Others are used for extraction procedures
  - One was eliminated procedurally

Only 4 items need to be replaced
Non-DEHP T Connector w/Swivel M.L.L.

CONTENTS: STERILE
AND FLUID PATH NONPYROGENIC UNLESS PACKAGE IS DAMAGED OR OPENED.

SLIDE CLAMP IS SPECIFICALLY DESIGNED FOR EASE OF REMOVAL. PREVENT INADVERTENT REMOVAL.

CAUTION: Federal Law (U.S.A) restricts this device to sale by or on the order of a physician.

Latex Free

SINGLE USE
Take Home Message

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DEHP Resources

- Sustainable Hospitals:  
  www.sustainablehospitals.org

- Health Care Without Harm:  
  www.noharm.org
  - Audit Form:  
    http://noharm.org/details.cfm?type=document&id=741
  - Alternative List:  
    http://www.noharm.org/details.cfm?type=document&id=591