Bridging the evidence-practice divide: The science and policy of bisphenol A

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outline

• NCCEH – who we are
• Introduction to bisphenol A
• Health risks
  – Gaps
• Human exposure
  – Vulnerable populations
• Legislation and politics
• Alternatives for action
  – BPA substitutes
• Public health responses

Photo: marktwang@gmail.com
The NCCs

- One of six national collaborating centres
- Funded by the Public Health Agency of Canada (PHAC) – at arm’s length
- Each is hosted by a different institution
- Each focuses on a different aspect of public health
Bisphenol A
Science and Policy
bisphenol A

• Media and policy attention related to potential endocrine disrupting properties
• Lack of consensus on health risks
• Policy makers, practitioners, industry, and consumers must make choices based on uncertain information
bisphenol A

- Hardness + heat resistance + transparency
  - polycarbonate plastics (e.g. water bottles & baby bottles)
  - epoxy resins (e.g. can linings)
  - dental sealants
  - other food contact applications (e.g. plastic wrap, PET bottles)
  - PVC plastics
- Widespread production for >50 yrs
- >2 billion kg produced in 2006
### NTP–CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Bisphenol A

<table>
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<th>Some concern</th>
<th>• developmental toxicity in foetuses, infants, children (neurobehavioural &amp; prostate effects)</th>
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| Minimal concern | • developmental toxicity in foetuses, infants, children (mammary gland effects & early female puberty)  
• reproductive toxicity in occupationally exposed adults |
| Negligible concern | • reproductive toxicity in adults  
• foetal/neonatal mortality or birth defects  
• reduced birth weight and growth |
body burden & exposure

Most people carry detectable BPA

Exposure — adults
- EU 2003: <0.02–59 µg/kg/d
- NTP: 0.008–1.5 µg/kg/d

Exposure — infants
- EU 2003:
  0.2 µg/kg/d (breastfed)
  13 µg/kg/d (formula fed from polycarbonate bottles)
- NTP 2008:
  0.2–1 µg/kg/d (breastfed)
  1–11 µg/kg/d (formula fed)

Body burden — adults
- NHANES data, US
  2.6 µg/l urine
  (Range: 0.4–149 µ/l)
  BPA detected in 92.6% of people

Body burden — infants
- NICU patients
  30.3 µg/l (Range: 1.6–946 µg/l)
  BPA detected in ¾ of infants
  >90% conjugated metabolite
routes of exposure

- **Food**
  - Cans with epoxy resin lining, including baby formula
  - Polycarbonate storage containers, e.g. baby bottles, water bottles, food storage containers
  - Other food contact materials, e.g. paper towels, single-use containers
- **Dental composites containing:**
  - bisphenol A dimethyl acrylate (bis-DMA)
  - bisphenol A glycidyl methacrylate (bis-GMA)
- **Water**
  - PVC piping
  - Plastic water bottles
migration

- BPA migrates from food storage containers into food/beverage
- Factors affecting migration:
  - Fat content
  - Temperature
  - Migrates during can processing
  - Caffeine, salt, glucose
  - Repeated use??
infants and bisphenol A

1. **Dose** – infants consume more food relative to body weight
2. **Dose** – potentially receive entire diet from canned formula via polycarbonate bottles
3. **Metabolism** – lower hepatic enzyme activity to convert BPA to glucuronidated metabolite
4. **Timing** – infancy is key time for neurodevelopmental health risks
research gaps

• Epidemiology & low dose effects
• Mechanism & endpoints of BPA activity
• Data
  – rat strain
  – dosing method
  – analytical methods
• Conflicting conclusions
  – industry vs university
Canadian response

• Health Canada
  – April 2008: Initiated process to ban BPA in baby bottles, find alternatives, and list BPA as CEPA toxic
  – May 2008: No recommendations to change behaviour re consumption of canned foods
  – August 2008: No expected health risks from dietary exposure. Risk assessment suggests design flaws in research showing neurodevelopmental and behavioural effect, but indicative of vulnerable population of infants, so ALARA applied
Canadian response

• Health Canada
  – October 2008: 1. Proceeding with ban on importation, sale and advertising of polycarbonate baby bottles containing BPA; 2. Taking action to limit environmental release; 3. $1.7M to research over 3 years
  – 2009: Regulations expected this year
Canadian response

- Environment Canada
  - March 2008: Agree with Health Canada draft screening assessment on risks
  - CEPA toxic, section 64a (not bioaccumulative but acutely toxic to aquatic organisms)

Photo: Health Canada
international response

US — FDA, NTP
- April 2008: FDA reviewed NTP & Canadian risk assessment and found no need to take action
- Sept 2008 NTP-CERHR: Some concern for developmental neuro-behavioural effects
- FDA feels current exposures are safe but additional research on low dose exposure imp.
- June 2009: FDA will re-examine BPA issue

City/State-level actions
- Minnesota — prohibiting sale of containers with BPA for children <3 as of 1 Jan 2010
- California — bill passed Senate
- NY — bill pending
- Connecticut — bill to ban BPA passed Senate vote, pending re-approval by House
- Chicago — city may ban containers for children
international response

EU — EFSA

• Jan 2007 TDI = 0.5 μg/kg bw
• July 2008: reviewed NTP & Canadian risk assessments and found no reason to change TDI
• Oct 2008: closely monitoring new findings, but no ability to find causal link with chronic illness
BPA alternatives

- Glass/porcelain
- Stainless steel
- BPA-free plastics
  - Acrylic
  - Polystyrene
  - Styrene-acrylonitrile copolymer
  - Polypropylene
  - Polyamide
  - Tritan™ copolyester
- BPA-free can coatings
  - Some non-epoxy coatings approved
chemical substitution

- Polycarbonate plastics are being replaced by BPA-free plastics
- **Substitution**: effective health protection mechanism IF a known hazard is replaced with a less hazardous known chemical
- Replacing a suspected hazard with an untested substitute MAY be more hazardous
- **Careful design and testing is essential**
questions remain

- Research gaps remain
- Exposure control challenging
  - BPA is ubiquitous
  - Non-monotonic dose-response?
- The devil you sort of know…
  - Substitution effects – What’s in the new plastic?
  - Efficacy of alternatives to epoxy resins
- New evidence → more questions
it’s not black and white

• Political issue
  – public outrage requires action or explanation
  – science alone does not determine political response
  – health policy = science + politics + economics

• Appropriate public health responses consider:
  – weight of evidence
  – effectiveness of interventions
Thank you!
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