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Representative Diana Urban
Legislative Office Building, Room 4042
Hartford, CT 06106-1591

Dear Representative Urban,

I offer the following comments regarding the proposal to replace the Connecticut statute which prohibits the manufacture, sale or distribution of children's jewelry that contains cadmium at more than 0.0075 per cent by weight (75 parts per million, or ppm) with the standards contained in the ASTM F2923-11 *Specification for Consumer Product Safety for Children's Jewelry.* The ASTM standard establishes a limit of 300 ppm total cadmium content, and provides that if cadmium content exceeds 300 ppm further testing must be performed to make certain that the bioavailable cadmium extracted does not exceed specified levels.

I make my comments on the basis of having done extensive testing of inexpensive and children's jewelry for both lead and cadmium, and on the basis of having done the most extensive published study[1] on cadmium bioavailability that has been published in the peer-reviewed scientific literature. I have separately included a copy of this paper which was recently published in *Environmental Health Perspectives*. Furthermore, of the four recalls of children's jewelry items for cadmium content and one additional warning about high cadmium content in a jewelry item which have been issued by the US Consumer Product Safety Commission, three of the items were identified as hazardous through testing in my laboratory and reported to the Commission prior to those actions.

It is my opinion that the ASTM F2923-11 test procedure is not adequate to protect children's health with respect to potential hazards of cadmium in children's jewelry.

1. Cadmium is an extremely toxic metal which bioaccumulates in the body. The toxicity of cadmium is well-established in the scientific literature, with primary concerns from chronic exposure including osteotoxicity and kidney damage. A recent review[2] indicates that a significant fraction of the nonsmoking population in the US (smoking being a significant route of cadmium exposure) has cadmium levels high enough for measure impacts on kidney function to be seen. The authors of this review concluded that "this implies no margin of safety" between current levels of exposure to trace levels of cadmium through the diet and

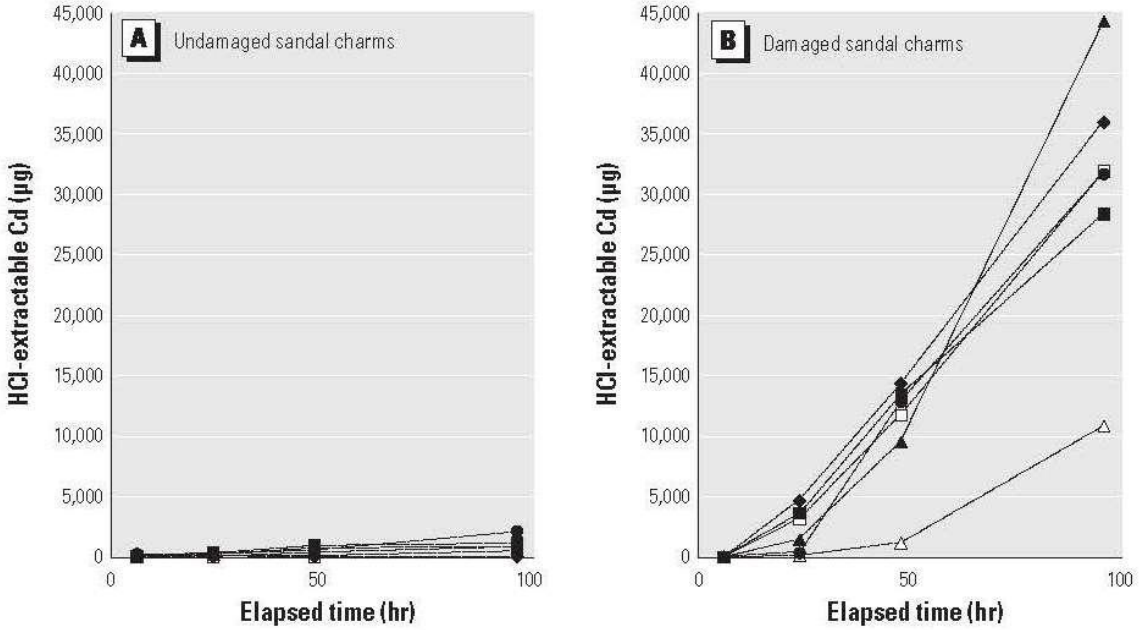
other sources, and levels that would adversely affect health. Thus any exposure of children to cadmium early in life could result in kidney damage and osteoporosis later in life.[3]

2. The ASTM standard assesses the potential hazards of jewelry items containing more than 300 ppm total cadmium by one of two tests for extractable cadmium. Small items are tested to measure the cadmium that is leached by exposure to a dilute hydrochloric acid solution, simulating exposure to stomach acids. Larger items are tested by measuring the cadmium that leaches into a saline solution, simulating the mouthing of the item.

   The logic of basing the ASTM standard on cadmium bioavailability is that if the cadmium is in a form that cannot be leached from the jewelry item by mouthing or swallowing the item, then there is no hazard to a child. The fundamental problem with the ASTM standard is that there is no provision for testing jewelry items that have experienced damage expected through normal wear and use. Damage to the outer surface of an inexpensive children's jewelry item may be expected through abrasion or if a child bites the item, but the ASTM standard gives no consideration to this possibility. The breaching of an outer electroplated coating on a jewelry item by such damage may greatly change the leaching characteristics of the jewelry item, and potentially put a child at greater risk of cadmium exposure from that item. (By contrast, the ASTM standard mandates "use and abuse" testing as part of determination of safety of children's jewelry items which contain magnets.)

3. Testing in my laboratory[1] has shown that damage to a jewelry item can greatly affect the amount of cadmium leached from jewelry items in the bioavailability extractions. We have observed that sometimes the amount of cadmium released is increased, while other times it is decreased due to this damage, presumably due to electrochemical effects based on what metals are exposed to the extracting solutions. However, with the dilute hydrochloric acid extractions used to simulate a worst-case ingestion scenario, the bioavailable cadmium released by some jewelry items increased by more than 10-fold.

   The data on the next page are taken from our published paper on cadmium bioavailability.[1] These graphs show the amount of cadmium extracted with dilute hydrochloric acid from six undamaged and six damaged charms from the same jewelry item. The results are summarized below the graphs. Of significance relative to the present discussion is the fact that the amount of cadmium released from these charms increased more than 10-fold when they were damaged, from an average of 121 micrograms over 24 hours for undamaged charms (below the 200 microgram threshold in the ASTM standard) to an average of 1586 micrograms for the damaged charms. The average total cadmium content of these charms was 39.1% (391,000 ppm). The ASTM standard does not impose an upper limit on cadmium concentration, provided that jewelry items pass the appropriate leaching test. Thus the charms tested are an example of items that might pass the extraction tests provided by the ASTM standard, but could pose a serious threat to a child.



Average cadmium release after 24 hours for undamaged charms: 121 micrograms; 2 of 6 charms exceeded 200 micrograms.

Average cadmium release after 24 hours for damaged charms: 1586 micrograms; 5 of 6 charms exceeded 200 micrograms with a maximum release of 3320 micrograms.

Average total cadmium content of these charms was 39.1% (391,000 ppm). Note: The numbers above reflect the 30% subtraction of the inter-laboratory correction factor as specified in ASTM F2923-11.

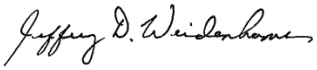
Data are from Weidenhamer et al. (2011)[1]

Connecticut is not alone in regulating the cadmium content of jewelry based on total content. The European Union has recently enacted a standard restricting the cadmium content of all jewelry items to a maximum cadmium concentration of 0.01% or 100 ppm, effective December 2011.[4] Unlike other potentially harmful metals such as chromium, which can impart useful properties to steel and is generally recognized as safe when used properly in jewelry and implanted medical devices, there is no inherent functional reason why cadmium needs to be in children's jewelry at high concentrations. I have analyzed many children's jewelry items that contain less than 75 ppm cadmium, supporting the conclusion that cadmium is not essential in these items.

While total content standards do not take potential bioavailability into account, a standard based on bioavailability must take the actual use of the item into account. In the real world, children wear their jewelry, and exposure to cadmium may come from mouthing or swallowing jewelry that has been abraded or bitten. As detailed above, my data indicate that this damage can greatly increase the amount of cadmium released from the item. Testing unabraded, undamaged items as provided in ASTM F2923-11 is thus inadequate to identify jewelry that in real-life use may

endanger young children. Given the seriousness of the lifetime health consequences posed by childhood exposure to cadmium, this is a fundamental flaw in the ASTM F2923-11 method. For these reasons, I believe that the current Connecticut law is more protective of children's health than the new ASTM F2923-11 *Specification for Consumer Product Safety for Children's Jewelry*.

Respectfully submitted,



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[1] Weidenhamer, J. D., Miller, J., Guinn, D., & Pearson, J. (2011). Bioavailability of cadmium in inexpensive jewelry. *Environmental health perspectives*, *119*(7), 1029.

[2] Järup, L., & Åkesson, A. (2009). Current status of cadmium as an environmental health problem. *Toxicology and applied pharmacology*, *238*(3), 201-208.

[3] Schoeters, G., Hond, E. D., Zuurbier, M., Naginiene, R., Hazel, P., Stilianakis, N., Ronchetti, R., & Koppe, J. G. (2006). Cadmium and children: Exposure and health effects. *Acta Paediatrica*, *95*, 50-54.

[4] COMMISSION REGULATION (EU) No 494/2011. Available online: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:134:0002:0005:EN:PDF