



A Potential New Health Risk From Lead in Used Consumer Products Purchased in the United States

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Abstract The Lead Renovation, Repair, and Painting Rule and the Consumer Product Safety Improvement Act, both enacted in 2008, were intended to protect children from exposure to lead by setting federal limits on lead content. Neither of these federal actions, however, addresses a newly recognized pathway of exposure to lead from the use of used consumer products in the home. In the study described in this article, the authors purchased 28 used consumer items in the United States in 2004 and analyzed them for lead content using X-ray fluorescence technology. Nineteen of the items exceeded the federal standards for lead. The amount of lead in the items ranged from 745 parts per million (ppm) to 428,525 ppm. The authors' research shows that such items, which are easily purchased throughout the U.S., may contain surface lead concentrations in amounts greater than 700 times current federal limits. This article reveals an ongoing public health threat involved in exposure to lead that is not addressed by current laws or regulations. Addressing the risk involved in this threat requires continued research, public education, and targeted regulatory action.

Introduction

In 2008 the U.S. Congress passed the *Consumer Product Safety Improvement Act* (CPSIA) of 2008 (H.R. 4040 2008). Also in 2008, the U.S. Environmental Protection Agency (U.S. EPA) promulgated the Lead Renovation, Repair, and Painting Rule (LRRP). Both actions are intended to protect children from exposure to lead. An emerging public health threat not addressed by either the LRRP or the CPSIA, however, is the possible exposure to lead that may occur from the use of old building components that are "salvaged" and resold to consumers who use them for remodeling work; and a new home decorating fashion that uses antique collectibles, old dishes and toys, and

second-hand furniture with damaged paint (Sharmer, Northrup-Snyder, & Juan, 2007). In our study, we purchased 28 second-hand items in the United States in 2004 and analyzed them for lead content; our results are presented here.

Exposure to deteriorating lead-based paint and lead-contaminated dust and soil from old housing continues to be the primary cause of elevated blood lead levels (BLLs) reported among U.S. children (Levin et al., 2008). The LRRP Rule, which was promulgated in 2008, includes requirements for training workers, contractors, inspectors, and others who are employed in construction work on "target" housing (i.e., housing occupied by children).

The regulation is intended to prevent children from being exposed to lead while lead-based paint remediation in old houses is underway (Lead Renovation, Repair, and Painting Rule [LRRP], 2008). In particular, the regulation applies to older housing that is being demolished or rehabilitated as part of nationwide redevelopment and revitalization projects, including those funded by the American Economic Recovery and Reinvestment Act of 2009 (Farfel et al., 2003, LRRP, 2008).

Much of the focus of rehabilitating houses to remove lead-based paint hazards has been on older rental houses in impoverished neighborhoods. Children in families with a higher socioeconomic status and who live in older houses undergoing home renovation by individual family members, however, are at risk as well (Centers for Disease Control and Prevention [CDC], 2009; Lanphear, Dietrich, & Berger, 2003; Mielke, Powell, Shah, Gonzales, & Mielke, 2001). The LRRP Rule does not apply to individual homeowner renovations (LRRP, 2008). In addition, while much of the focus of lead exposure is on children, recent research reports that low levels of exposure over time also pose a serious threat to the health of adults, causing damage to the heart, kidneys, and brain (Spivey, 2007).

The objective of the CPSIA is to prevent children's products with hazardous amounts of lead from entering the retail stream. The law went into effect on February 10, 2009, and requires the amount of lead in products intended for use by children and regulated by the Consumer Product Safety Commission (CPSC) to be reduced to no more than 0.01%

TABLE 1

Lead Concentration on the Surface of Selected Second-Hand and Antique Household Items and Comparison to CPSC Standard

Item Description	Lead (ppm)	Number of Times Lead Concentration Exceeds CPSC Standard (600 ppm) ^a	Possible Use of Item
Salt shaker lid-1	428,525	714	Food service
Salt shaker lid-2	365,275	609	Food service
Small red toy teapot	318,453	531	Food service, toy
Garfield cup	277,579	463	Food service
Turtle necklace	236,225	394	Jewelry
Red pyrex casserole	154,635	258	Food service
Ceramic doll head	109,759	183	Toy
Dump truck	50,635	84	Toy
Small truck	34,383	57	Toy
Shutter	23,161	39	Home decor
Small vinegar cruet	17,082	28	Food service
Potato ricer (handle)	15,783	26	Food service
Garden cultivator	11,032	18	Home decor
Plastic duck (beak)	10,444	17	Toy
Pewter pitcher (lid)	6,756	11	Food service
White window frame	4,747	8	Home decor
Ice cream scoop	1,063	2	Food service
Pewter bowl	776	1	Food service
Milk glass pepper shaker	745	1	Food service
Japanese wine cup	523	<1	Food service, home decor
Russian doll	190	<1	Toy
7-UP bottle	17	<1	Home decor
Red wood apple	7	<1	Home decor
Spinning top	0	<1	Toy

^a Rounded to nearest whole number.

by weight of the total weight of the product (or 100 parts per million [ppm]) over a period of three years, beginning in 2009 (Consumer Product Safety Improvement Act [CPSIA], 2008). The CPSIA covers only items intended for use by children, however, and does not regulate items such as second-hand food service products or antique or collectible toys, which are not defined by law as children's products.

Methods

Twenty-eight different used items with a positive qualitative lead result were purchased from second-hand stores, antiques shops, or salvage centers in New York, Virginia, and Oregon in

2004. The products included toys, ceramic and pewter dishes, a window shutter, a salvaged window, and numerous miscellaneous decorator items. The used items were initially tested for lead content using a qualitative swab test (Hybrivet, 2008) in the store. The items were then further analyzed quantitatively for lead content in 2006. During the time period from purchase to quantitative analysis, the items were stored in a locked cabinet.

Laboratory Sampling, Analysis, and Instrumentation

All 28 items were analyzed one time only using a Spectrace/Thermo QuanX energy-dispersive X-ray spectrometer at the Geoarchaeological

XRF Laboratory at the University of California, Berkeley. The items were analyzed whole with little or no formal preparation, although some of the samples required breakage in order to fit in the sample chamber. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate X-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy & Schamber, 1981; Schamber, 1977).

The spectrometer was equipped with an electronically cooled copper X-ray target with a 125 micron beryllium window, an X-ray generator operated from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ reduction software. The X-ray tube was operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) palladium primary beam filter in an air path at 200 seconds livetime to generate X-ray intensity K α -line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), rubidium, cobalt (Co), zinc (Zn), gallium (Ga), (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb), lead (Pb), and L α -line data for thorium (Th). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju, 1994). Specific standards used for the best fit regression calibration for elements of interest include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), GXR-1 (jasperoid), all U.S. Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (Govindaraju, 1994).

The data were translated directly into Excel™ for Windows software for manipulation and into SPSS™ for Windows for statistical analyses. To evaluate these quantitative determinations, machine data were compared

to measurements of known standards during each run. An analysis of RGM-1, a USGS rhyolite standard, was analyzed during each run; additionally, USGS Jasperoid GXR-1 was analyzed in one run to assess instrument precision. Further information on the laboratory instrumentation and repeated analyses of RGM-1 may be found at www.swxrflab.net/. For the most part, the items were irradiated at the place where they had been previously swabbed with the qualitative testing device.

Results

The lead concentration of the items purchased by the researchers is shown in Table 1 and is expressed in parts per million (ppm), a quantitative measure by weight. Lead concentrations in the tested items ranged from a low of 0 ppm for a spinning toy top to a high of 428,525 ppm for a saltshaker lid. Nineteen of the tested items (79%) exceeded the current CPSC standard (600 ppm) for paint. The lead concentration in those items that exceeded the CPSC standard ranged from a low of 745 ppm in the decorative paint on a milk glass pepper shaker to a high more than 700 times the allowable CPSC level in a metal saltshaker lid.

High lead concentrations were found on items that are intended for use in food service, as toys, in home decor, and as jewelry. Although a few of the items were known to be manufactured outside the U.S., most were apparently manufactured domestically, but prior to the enactment of the current CPSIA. A small red nesting Pyrex casserole (see photo next page, top) that had been manufactured in the United States and is of the type one could reasonably expect to find in a typical American kitchen cupboard, had more than 154,000 ppm of lead in the paint on the outside of the bowl. A drinking glass featuring Garfield the Cat was found to contain lead paint in the lip area in excess of 463 times the CPSC standard. A turtle-shaped necklace was found to contain 394 times the CPSC standard.

Several second-hand toys were found to contain excessive concentrations of lead, including a toy teapot, the head of a ceramic doll, two small toy trucks, and a ceramic duck. The two salvage items, a white window frame (see photo next page, middle) and a blue painted window shutter, both exceeded the CPSC standard for paint. The window

had eight times and the shutter had almost 40 times the allowable concentration of lead. Paint on the window frame was deteriorated to the point that a chalky residue was picked up on the hands of the researcher (see photo next page, bottom).

Discussion

Previous research (Sharmer et al., 2007) showed that the use of second-hand items and building salvage used for home decor and home renovation purposes is aggressively promoted in the print media. The research also showed that it is possible for an individual shopping in salvage centers or second-hand stores in the United States to unknowingly purchase products that contain lead. These kinds of retail sales are unregulated by the government and therefore pose a potential human health threat to the initial consumer of the items and end users of the items, which may include children.

The CPSC has the authority to recall new toys and other household items in retail commerce that are identified as having high levels of lead. In November 2008, the CPSC issued a press release warning parents about purchasing less expensive second-hand or used toys at second-hand shops where some of the previously recalled toys may be available for sale (Kerr & Metzler, 2008). The following year, on January 8, 2009, the CPSC attempted to address the issue of lead in used consumer products being offered for sale in thrift and other second-hand stores by clarifying the applicable law it was authorized to enforce:

Sellers of used children's products, such as thrift stores and consignment stores, are not required to certify that those products meet the new lead limits, phthalates standard or new toy standards. The new safety law does not require resellers to test children's products in inventory for compliance with the lead limit before they are sold. However, resellers cannot sell children's products that exceed the lead limit and therefore should avoid products that are likely to have lead content, unless they have testing or other information to indicate the products being sold have less than the new limit. Those resellers that do sell products in violation of the new limits could face civil and/or criminal penalties (CPSC, 2009).

The official statement above indicates that although sellers who sell second-hand items intended for children may not sell such items that contain lead in violation of the new standard, no affirmative requirement exists for the seller to either test for lead or certify that such items are lead safe. Although the CPSIA specifically addresses children's products, it does not address items such as antique toys, which are not intended for use by children, but which would have significant appeal to a child.

Although such consumer items can be purchased at licensed businesses such as salvage yards or antiques shops, which come under the jurisdiction of the CPSC, they are also widely available over the Internet (Allen, 2002) and at thousands of flea markets, garage sales, tag sales, auctions, and rummage sales held every day in the U.S. Sales of such household items are not restricted and it would be almost impossible to regulate the lead content in such products.

No federal regulations, including the LRRP Rule, prohibit the sale of building rubble and salvage with lead-based paint to salvage yards, junk shops or antiques stores, or their reuse by consumers. In addition, salvaged construction rubble that is for sale in the antiques trade may be quite expensive. The white painted window that was purchased for this study cost \$85.00. The window itself was similar to one that might be found on an old dilapidated shed. A white painted entry door that was also positive for lead on the qualitative test was for sale for \$895.00 at the same antiques shop where the window was purchased. Families who can afford to pay \$895.00 for a used door are not likely to be living in an impoverished neighborhood, but children's health care providers who continue to assume the only children at risk of lead poisoning are those who live in poor neighborhoods may not think to suggest blood lead screening for their patients in middle- or upper-class families. As a result, the public health threat identified in this paper may continue to be unrecognized and underappreciated by traditional health care providers.

We have no way of knowing the full extent of this trend, nor do we know the prevalence of these items in homes throughout the U.S. The study was limited to a readily available and convenient sample of second-hand items

commonly found in second-hand and antique stores. The ease with which items could be found and purchased by the authors, however, suggests that they are widely available. In addition, during weak economic times, consumers may turn to second-hand household items that are less expensive than new items, and this, in turn, may exacerbate the public health threat.

Limitations of Qualitative Tests

While we were surprised at the ease with which items with high lead concentrations could be purchased in these second-hand shops, we also recognize that objects that initially tested negative with the LeadCheck Swabs, may have, in fact, been positive for lead. Recent research has revealed that almost two-thirds of samples taken in accordance with LeadCheck Swab test kit instructions that generated a negative result actually had hazardous levels of dust lead (Korfmacher & Dixon, 2007). This finding suggests that consumers should be educated about the limitations of LeadCheck Swab tests to determine lead hazards in used items that will be placed within the home, and that guidance for the use of these tests should clearly explain the risks of false negatives and provide appropriate follow-up actions when negative results are obtained (Korfmacher & Dixon, 2007).

Limited Current Educational Efforts

Since effective regulation of the lead content in used consumer items is problematic for several reasons (including some described above), regulators and health care providers should develop and make available to consumers a comprehensive and effective public education program. The U.S. Department of Housing and Urban Development (HUD) recently funded a pilot program to educate child and family health care providers about this issue. The Childhood Lead Poisoning Prevention Program of the Oregon Department of Health collaborated with HUD on the project, which called for health care providers in U.S. Region 10 (Alaska, Idaho, Oregon, Washington, and 267 Native American Tribes) to be informed of the issue by way of a mailed public health notice. The mailing included a brochure with photographic examples of potentially hazardous products. The pilot program also

included an educational Web site that could be accessed by both health care providers and consumers.

Evaluation of this educational program is currently occurring and preliminary evaluation data show that mailing educational materials to health care providers may not be an effective way to reach them. Almost 40% of the health care providers surveyed for the evaluation could not remember receiving the notice. We recommend a new and vigorous public health education campaign that uses the most recent research in marketing theory as well as a widespread and effective use of the electronic media and the Internet.

Conclusion

In 2007, when official government inspections revealed harmful levels of lead in toys for sale in the United States, Congress and President George W. Bush quickly took action. A new law intended to ameliorate the problem was introduced in November 2007, passed by both houses of Congress and signed into law by the president in August 2008. The new law reduces the amount of allowable lead in children's products over a three-year period, beginning February 10, 2009. Despite that effort, the American public is today faced with a much broader problem related to lead in used consumer products that are being offered for sale in the United States. Regulating the sale of such goods at flea markets, garage sales, rummage sales, and those sold over the Internet would be practically impossible and probably very expensive. Exacerbating the problem is the fact that old, shabby, worn-out consumer items are popularly promoted as charming and chic (Ashwell, 2000; Bowles, 1993; Hughes, 2010).

No socioeconomic group, geographic area, or racial or ethnic population is spared the risk of lead poisoning from this new decorating trend. Solving this problem will require a sustained and concerted effort on the part of public health care providers; federal, state, and local regulatory agencies; and the media, researchers, and consumer educators.

We submit that the most important first step in reducing the present health threat will be to educate consumers about the risk of lead in used consumer items, and the known limitations of the LeadCheck Swabs as a screening device for lead painted sur-



The paint on the outside of this small nesting casserole dish has lead in excess of 250 times current federal standards.



The frame of this window, which was purchased for \$85.00 in an antiques store, is covered with chalky lead-based paint.



These are the fingers of the researcher after handling a salvaged entry door covered with chalky lead-based paint. The door was priced at \$895.00 in an antiques store.

faces. Expanding the HUD Lead Outreach project to a national level, and educating the public, consumers, the media, and health care providers will be key. State-

of-the-art research in effective marketing approaches should be investigated and multiple modes of communicating information about the health threat should be employed to reach consumers and end users who would be inclined to purchase and use second-hand or salvaged goods in their homes. In addition to education, continued research and official regulatory action will be additional necessary steps to close the regulatory gap and create a solution to this public health threat.

Well-informed and educated American consumers can help inform the direction of fads and fashions that are potentially harm-

ful to children. Advertisers are sensitive to public sentiment and are likely to pull advertising dollars from media that do not receive popular public support. For this reason, the education of consumers must come first. This means it is now the responsibility of individual families and their health care providers to protect the next generation of American children from the hazards in the items of generations past. Educated policy makers, researchers, parents and caregivers, physicians, nurses, and public health workers and a desire on the part of all to keep children safe will be the best resource to fight this new problem. 🐞

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