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Children's Safety: Toxic Substances in Toys

There is no surprise that chemicals are a major component in many daily products even though the words, "chemical compounds" always give negative impressions, regardless of how significantly they have transformed the quality of our lives. However, there is a legitimate concern: do the manufacturers choose appropriate materials that do not cause any safety or health issues? Recently, toxic substances have been discovered in toys imported from foreign countries or manufactured in the United States. Those sold at lower prices are more likely to have been produced with cheaper materials.

In September 2013, an award-winning baby toy, "Start Your Senses", a stuffed zebra made by Bright Stars, was found to contain aniline yellow, the dye that was used in inkjet printers, insecticides, styrene resins and waxes...etc. (12) In the 1980s, it caused a toxic reaction in humans that killed 400 people and left over 20,000 people sick, known as the Toxic Oil Syndrome. The retailers immediately recalled the products for refunds because of the safety issue. In June 2010, McDonald's had its drinking glasses recalled because of the heavy-metal, Cadmium paint on the surface. Numerous products containing different types of toxic chemicals are common. It is important for government to establish a regulation that bans the use of toxic substance in daily products.

Cases that concern children's toys are taken more seriously because of several reasons. First, children tend to put objects in their mouths and chew on them. (1) Therefore, children may absorb chemicals contained in toys and other products. Second, with higher surface-to-body ratios and higher metabolic rates, children are more likely

than adults to contact toxic substances and have them circulate in their bodies. Third, the relatively higher amount of air, water, and food intake also increases the impact of chemicals on children. In other words, chemicals have a higher chance to accumulate in children because children do not have fully developed immune system. With higher chemical intake, toxic substances cause a higher impact on children than on adults.

Toxic substances are used to lower manufacturing cost. Because of the global trend that demands low-cost products, many companies move their factories to developing countries where labor costs are lower, working conditions are severe and pollution is serious. In China, where 75 percent of toys in the world are made in over 8,000 toy factories with more than 3.5 million employees, many workers work over 15 hours a day but receive less than 300 US dollars a month. (13) The workers are mainly mid-aged, unskilled women who are not able to work elsewhere. With low budgets, factories are tempted to choose cheaper materials despite safety concerns. There is no global information system that tells people what substances can or cannot be used in a particular product. Although environmental organizations have started to pay attention to hazardous chemicals in daily products, there is always a delay between regulation and industrial production as more and more chemicals are found to be harmful to the human body. Further, some harmful materials remain unknown. For example, paints and coatings of toys may contain lead obtained from low-cost recycled electronic waste and lead batteries. The Consumer Safety Product Commission (CPSC) of the United States adopted EN71-3, the limitation on toxic substance in manufacturing proposed by European countries (8) to strictly limit the use of lead. The manufacturers turned to cadmium which was used in a similar way as lead. Several compounds containing cadmium are believed to be

carcinogens; the ingestion of cadmium is extremely harmful. Because there was a lack of literature about the toxicity of cadmium and its impact on the human body, the manufacturing limit of cadmium was not as strict as that for lead. In 2011, Harvard University released a study of 2,000 children who had significant contact with cadmium; the study showed that cadmium may increase the possibility of suffering learning disabilities by a factor of three. (16) The Harvard study gives a large range of both documented and undocumented chemicals used in manufactured goods that might lead to defects in humans.

Toys that contain toxic substances were sold globally. When I was a child, I remember receiving a mysterious pen. One side of it was a pen with invisible ink while the other side contained a purple bulb that emitted light of a certain wavelength to reveal the fluorescing chemicals. This magic toy fascinated me. Only later I realized that the “invisible ink” included ethylene glycol, a dangerous chemical if put directly on the skin. Recently, the Secret Writer Ink, manufactured by National Ink, Inc, was found to contain ethylene glycol phenyl esters and diethylene glycol mono ethyl esters, hazardous chemicals when in contact with skin. (10)

Some of the banned or limited chemicals are widely used in industrial manufacturing processes. The plastic toys, mainly made of polyvinylchloride, often contain metal stabilizers or phthalate plasticizers that are used in polymerization. (8) Because of their function as plastic softeners, soft “safe” toys, such as bathtub toys, bibs, and chewing toys for infants contain phthalates. Continuous exposure to products containing those chemicals above regulatory limits might cause hormone disruption, impact sexual development, cause asthma and skin diseases. Studies showed that the majority of babies

exposed to those products had phthalate residue in urine samples. Similarly, bisphenol A (BPA) was widely used in polymerization processes, such as those for polycarbonate for baby bottles. Studies showed that BPA might disrupt hormone function and increase the possibility of cancers. (15) In 2006, San Francisco enacted the first bill in the United States, known as the “Stop Toxic Toys” bill that banned phthalate and BPA.

Toys with fancy coloring or coating lead to illness. When children scratch or chew on toys, paints containing heavy metals might fall off and migrate into the mouth along with saliva, or contact skin through sweat. The most frequently used metal in paint is lead that may interfere with the development of children’s brains. Lead is included in paint because most colorings are lead compounds, such as white lead (II) carbonate or yellow lead chromate. Because a small amount can cover a large area, lead compounds lower the cost of manufacture. (3) Because of their resistance to rust and because of their very low solubility in water, most of them can function as water-resistant paint. The United States banned the use of lead in children’s toys and products in 1962. Those toys that contained more than 0.06 percent lead must be recalled. However, the biggest concern about lead products are those made in China. Reports showed that at least one third of the toys from China contained excess lead and over 10 percent of children in China suffered lead poisoning leading to kidney failure or brain damage from toys, contaminated food, or water. In 2007, Mattel and its branches recalled more than 30 million of their “Dora the Explorer” and “Sesame Street” toys due to lead contamination. (14) Fortunately, the Chinese government has now banned the use of lead paint in pet food, toothpaste, and children toys to improve product safety. China is the so-called the global factory; 80% of

their manufactured goods are shipped all over the world. Heavy metals are a major category of hazardous component in children's products.

The transition metals have their d-orbital split. When light excites the electrons, the wavelength of the energy difference between orbitals determines its color. As a result, transition metals are often used as pigments or colorants in products. (11) The health impact of metal is often due to the body conditions of workers who work with a particular metal. For example, workers working with cobalt were frequently diagnosed with bronchial asthma and other lung diseases. Further examination showed that their bodies had high levels of cobalt in their kidneys, lungs, and spleens. Those symptoms are the consequence of an extreme level of exposure. Because there has not been a study of symptoms from using daily products containing metal, it is difficult to set a specific limit for every single chemical that might have a potential impact on human health.

With greater attention to product safety, the US government has taken action toward regulating the use of chemicals in manufacture. Proposition 65 of California, known as "The Safe Drinking Water and Toxic Enforcement Act", administered by the Office of Environmental Health Hazard Assessment (OEHHA), was initiated in 1986. It required companies to indicate the amount of every chemical in the products they sell or release to the environment. It helped Californians to protect themselves from exposure to known toxins. (17) The "Children's Safe Products Act" of Washington State, known as the law that was "stronger than any chemical disclosure law", was passed in 2008 to require any company with more than \$1 billion annual gross revenue to report any chemicals contained in its products that may be chewed by children under three year old or may have direct skin contact by children under the age of twelve. (2) As a result, the majority of popular-

brand products had chemicals of high concern. Cobalt was found in Lego bricks, Gap bibs, New Balance shoes....etc as pigments. Ethylene glycol was found in Gymboree bibs and Little Tikes toys. Numerous other chemicals were also found in dolls, clothes, and textiles. The California Toxic Toy Bill (AB1108) in 2009 limited the concentrations of di-(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), and benzyl butyl phthalate (BBP) in toys and child-care products. (4) Items with higher than 0.1% of the listed chemicals are prohibited in manufacture, sale, or distribution. This bill requires the manufacturers to use alternate materials to replace those that have the potential to be harmful, especially to children under three years old who are more likely to absorb those chemicals through the mouth.

To establish an effective system for regulating product safety, it is important to begin with how the chemicals are detected. Atomic absorption spectrometry, X-ray fluorescence, and neutron activation analysis are possible techniques for determining the contents of particular compounds or elements. However, the majority of analytical instruments require tedious sample preparation that is time-consuming. Recently, laser-induced breakdown spectrometry (LIBS) was introduced for simpler sample detection. (7) Laser emission of excited atoms, ions, and molecules can generate a microplasma that vaporizes a tiny part of the sample. LIBS is best used for determining Ba, Cd, Cr, and Pb in plastics. The X-ray fluorescence spectrometer (XRF) is also popular for detecting elements. It uses X-rays or gamma rays to trigger ionization of the sample that expel electrons. When the electrons return to the ground state, energy is released as radiation, that can be used for identifying the element.

However, ensuring the safety of the products for children is not only the responsibility of the government but also that of industry. In *Toxic Chemicals in Toys and Children's Products: Limitations of Current Responses and Recommendations for Government and Industry*, Becker et al gave some recommendations for improved regulation of toxic substances. (1) The government should require all manufacturers to disclose all the components of their products and their potential toxicity. Customers have the right to know what they are buying. We need mandatory restrictions for chemicals with known toxicity and promotion of safe manufacture of children's toys. Industry must do research on all the chemicals they use in their products and work together with government that establishes regulations to make products safe for children.

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