Report on the Development of a Candidate List for Designation as Priority Chemicals under Maine's Kid-Safe Products Act

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Introduction

In 2008, the Maine Legislature passed Public Law Chapter 643 - An Act To Protect Children's Health and the Environment from Toxic Chemicals in Toys and Children's Products (commonly known as the Kid-Safe Products Act); a law aimed at protecting children from exposure to potentially harmful chemicals.[1] The first step called for under this legislation was compilation of a list of Chemicals of High Concern (Maine CHC List); the initial list was completed and was posted to the Maine Department of Environmental Protection (Maine DEP) website in June of 2009.[2] This list contains approximately 1,700 chemical substances that have met persistence, bioaccumulative, and/or toxicity criteria in order to be included. The next phase of the legislation calls for determination of at least 2 priority chemicals on which to take action by January 1, 2011.[3] This report details a project to develop a list of potential Priority Chemical Candidates (**Table 1 - Priority Chemical Candidate List**) using scientifically supportable methodology based on the criteria outlined in the Maine Kid-Safe Products Act.[3] The purpose of this list is to aid in promoting swift action on multiple chemicals that meet criteria for inclusion on the Maine CHC List. The resulting list of proposed priority chemicals meet all of the applied research criteria.

Methodology

The methods used to develop the candidate list parallel the methods described for prioritization by the Maine DEP.[3] The specific criteria include: inclusion of the chemical on the Maine CHC list; evidence that the chemical is found in humans from biomonitoring studies (with emphasis on children); the potential for children to be exposed to the chemical (in toys, common household products, personal care products/cosmetics, food or water, etc.); the existence of potential alternatives to the chemical of concern; and chemicals that have been banned or restricted by other US or state regulatory entities (**Scheme 1 – List Development Methodology**). All criteria are based on the definitions contained within the Maine Kid-Safe Products Act.[1] All potential priority chemicals appearing on this list are included on the Maine CHC list or are degradation products of chemicals that appear on the list, which by definition under the statute, are included with the parent compound.

Scheme 1 – List Development Methodology

Base Chemical Candidates: Maine Chemicals of High Concern List

Criterion 1: Found in Humans through Biomonitoring?

Criterion 2: Can Maine Children be Exposed?

Criterion 3: Are Safer Alternatives Available?

Criterion 4: Ban or Restriction by Another State or the Federal Government?

Result: Priority Chemical Candidate List

Criterion 1: The first criterion used in development of the Priority Chemical Candidate list was detection of the chemical in humans in a biomonitoring study. Multiple studies were used to satisfy this criterion. The main studies used include: Fourth National Report on Human Exposure to Environmental Chemicals[4], Body of Evidence: A Study of Pollution in Maine People[5]; Body Burden Study: Toxic Exposures in the Green Mountain State[6]; Mind, Disrupted: How Toxic Chemicals May Affect How We Think and Who We Are[7]; Fire Retardants in Toddlers and Their Mothers[8]; Teen Girls' Body Burden of Hormone-Altering Cosmetic Chemicals[9]; Pollution in People: A Study of Toxic Chemicals in Washingtonians[10]; Is It In Us? Chemical Contamination of Our Bodies[11]; A Present for Life, Hazardous Chemicals in Umbilical Cord Blood[12]; and Earliest Exposures: A Research Project by Washington Toxics Coalition[13]. Several additional studies were also reviewed; however, these were not used as primary references.[14] In order to meet the biomonitoring criteria, the chemical had to be tested for and detected in humans; this included testing of blood, urine, umbilical cord blood, breast milk, etc. In many cases the specific chemical detected was a decomposition product, such as a degradate or metabolite, of the chemical of concern. [15, 16] Cases where degradates or metabolites were used are indicated in the notes for **Table 1**. Substances from the Maine CHC List which met the criteria described here were then considered in the next phase of the project.

Criterion 2: The potential candidate substances from the biomonitoring portion of the study were then further scrutinized using criteria for human exposure. The main emphasis was on chemicals that children may be exposed to directly through typical daily interaction. This included such things as toys and jewelry, cleaning and disinfecting products, personal care products or cosmetics, food and food contact products, and common household items (such as plastics, flooring/carpeting). In addition, potential exposure to chemicals through ambient environmental exposure was taken into account. This includes sources such as chemicals in the air, ground or surface water, soil or dust, etc. These are relevant because exposure may occur, not only to a chemical used directly, but also as a result of disposal of the chemical or product containing the chemical, or by a use that disperses the chemical into the environment. A variety of sources were utilized in determining potential exposure. These included, but were not limited to, the US Centers for Disease Control and Prevention (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) entries for various chemicals[17]; various United States Environmental Protection Agency (US EPA) sources available on their website; independent scientific reports[18, 19]; and information from general internet searches for candidate chemicals or chemical classes. In addition, several of the biomonitoring studies specifically monitored for the presence of certain chemicals in children and younger age groups. Detection of the chemical in children was taken as evidence for the exposure of children to those chemicals. Chemicals that were found to have potential for childhood exposure were then carried to the next step in the project.

Criterion 3: The chemicals that met the previous criteria were then subjected to a review, based either on the class or individual chemical structures, to determine if alternatives exist. This is a somewhat subjective screening and it should be noted that, while the existence of alternatives was used for meeting this criteria, specific alternatives for individual chemicals or chemical classes are not discussed or endorsed. Additionally, it should be noted that the Maine Regulations governing selection of Priority Chemicals under Chapter 643 specify that a safer alternative is presumed to be available if the

product containing the priority chemical has been banned by another US state.[3] In addition, lack of a specific safer alternative alone was not considered sufficient for removal of a chemical from the list of potential priority chemicals, but was used in a weight of evidence approach together with the other factors discussed (in particular Criterion 4 below). For a general discussion of alternatives assessment, please see the US EPA's Design for the Environment program.[20]

Criterion 4: The final criterion for development of the Priority Chemicals Candidate list was comparison of the draft chemical list to other priority chemical or restricted substances lists compiled by state or federal regulatory entities. For this study we included comparison with the NY Green Procurement list[21]; the Oregon Priority Persistent Pollutant list[22]; California Proposition 65 List[23]; and the US EPA's Chemical Action Plans[24]. Comparison of the draft list to these sources indicated if the chemicals on this draft priority list were considered to be a chemical of concern to other regulatory entities, and also further emphasized the need to develop such a list of priority chemicals. In addition to the lists above, close comparison of the proposed priority chemical list to the Washington State Reporting List of Chemicals of High Concern to Children (CHCC List) was undertaken.[25] The WA state list is still in draft form; however, because the Maine and Washington safer chemicals laws and criteria are similar, comparison of the draft Washington list to the priority candidate list generated here was deemed important. This comparison resulted in finding significant overlap between these two lists. It should be noted that several candidate chemicals that appear on the draft Washington CHCC List do not appear on our Priority Chemical list. This is due in part to slightly different criteria for inclusion on the two lists. For instance, the draft CHCC List contains chemicals that meet criteria for either biomonitoring or use in consumer products, whereas our list contain only those chemicals that were found in humans.

Chemicals that met all of the criteria listed above were included on the final proposed Priority Chemical Candidate list and can be found in **Table 1 – Priority Chemical Candidate List**. The chemical candidates on this list: 1) have all met the criteria in the Maine Kids-Safe Product act to be included on the Maine Chemical of High Concern list, 2) have been monitored for and found in humans, 3) have potential exposure to children, and 4) may have safer alternatives (this may include either replacement chemicals or processes) or have been restricted by other state or federal regulatory agencies. The chemical candidate list includes 32 chemical substances or groups of substances separated into 9 classes. Specific details for each class, such as exposure routes, special considerations for the class, and use of metabolites or surrogate chemicals for detection, are discussed separately below.

Chemical Class Discussions

Artificial Musks

Artificial Musks are a class of synthetic compounds that are used as fragrances in a number of consumer products, including perfumes and personal care products, cosmetics, air fresheners, detergents and other household cleaners.[9, 11] As such, they are likely to be widely distributed and available for exposure to adult and child populations from routine contact in the home. In addition, chemicals that are used in cosmetics and personal care products may have particular significance with

relation to exposure to teenagers and younger children, who may begin to use these products during childhood.[9] Two individual artificial musk compounds that are found on the Maine CHC list were combined into a single category due to similarities of structure and use.

Metals

The metals included in this list are antimony, arsenic, cadmium, lead, mercury and their compounds. In most cases, the metal itself was detected directly, rather than specific compounds of that metal.[4] The uses of these metals vary. All are naturally occurring elements and some exposure to these metals in the environment is likely to occur; however, there are additional sources of exposure that may be a result of specific uses of these metals and their compounds. Antimony is used as a catalyst and flame retardant in the production of plastics, rubber, and textiles.[26] Arsenic was used to preserve wood as a component of chromated copper arsenate (CCA), in pesticides, in LEDs, and as an alloy with lead in batteries.[17] Arsenic is no longer used for wood preservatives in residential and many commercial settings; however, wood containing CCA may still be in place. In addition, exposure to arsenic is through drinking water containing the metal is possible.[27] Cadmium is used in a variety of consumer applications, including pigments and batteries[17], and was recently found in high levels in costume jewelry for children[28]. Lead and mercury are also are included on the potential priority list. Both of these chemicals have been the source of much study and regulation.[29, 30] However, since use of these metals in consumer products is ongoing and potential exposure continues,[10] they are included on the priority list.

Parabens

Parabens are a class of compounds used as stabilizers and preservatives in cosmetics and personal care products; teenagers and younger children may be exposed to these compounds when using these products.[9] There were four individual paraben compounds on the Maine CHC list that meet the additional criteria; due to the similarities in structure and uses of these, they have been combined into a single entry for all four substances in the priority candidate chemical list.

Perfluorochemicals

Perfluorinated compounds (PFCs) are used for a variety of applications that may result in consumer exposure. Their water and oil resistant properties make them useful for stain protection of carpets and other household products, as well as a treatment for food contact paper.[31] There are a large number of individual perfluorinated compounds on the Maine CHC list. These compounds tend to undergo limit biodegradation in the environment and form common persistent degradates. Perfluorinated telomere alcohols have been shown degrade to the corresponding perfluorinated carboxylic acid in the environment.[15] Detection of the corresponding carboxylic acid can be indicative of the presence of the telomere alcohol. In addition, many of the PFCs are based on a substituted sulfonamide structure; these compounds have been studied and can degrade to the sulfonic acid and, potentially, the carboxylic acid.[16] Based on these routes of degradation, detection of the parent perfluorinated sulfonic acid or carboxylic acid may indicate the presence of the substituted sulfonamide;

however, it may be difficult to differentiate the individual substituted perfluorinated sulfonamide that resulted in exposure. Due to these considerations, the relevant PFC substances are combined into single entries based on perfluorinated alky chain length and acid end group.

Phenols

The phenols class covers multiple chemicals with a wide range of product usages. Examples of phenols on the priority chemical candidate list include substances used as monomers for the production of polymer resins, antiseptics found in common household products, stabilizers and surfactants in consumer products, as well as other uses. Exposure to chemicals in consumer products can occur as result of using the products that contain the chemical substance, from residues left behind after use of these products, or from exposure to these products in the ambient environment as a result of disposal.[17]

Phthalates

Phthalates are common chemicals used in a variety of applications.[18, 19] These include personal care products, such as soaps and lotions, cosmetics, soft plastics used in household items, such as shower curtains, car care products, flooring, sealants and adhesives. Use of or contact with consumer products that contain phthalates can result in exposure to the compounds. Phthalates generally metabolize quickly in the body and phthalate specific metabolites were used to indicate exposure to the parent phthalate.[4] The specific metabolites used for each phthalate are listed in the notes section of the table.

Polybrominated diphenyl ethers

The polybrominated diphenyl ethers (PBDEs) constitute a class of substances primarily used as flame retardants in many household products.[4, 24] These substances are typically mixtures of congeners, structurally similar compounds with varying numbers and positions of bromine, and the members of this class are identified using individual congeners as surrogates.[32] However, due to the wide range of compositions in these compounds and difficulties identifying which compounds results in exposure to the individual congeners, the PBDEs have been combined into a single class entry in the priority chemical list.

Polycyclic Aromatic Hydrocarbons

The polycyclic aromatic hydrocarbons are a class of chemicals that are primarily produced as by-products from burning fossil fuels, and would not be eligible for inclusion under the Maine Chapter 643 legislation as a priority chemical.[1] Naphthalene, however, has additional uses as a deodorant compound that may result in exposure of the general population and/or children and was included for this reason.

Volatile Organic Compounds (VOCs)

The volatile organic compounds constitute another class that covers a range of products and uses. Uses for these chemicals include solvents, plastics, indoor deodorants, paint, adhesives, caulking,

and dry cleaning.[4, 17] These compounds are volatile, meaning they will partition to the air, and exposure to these compounds can occur as a result of breathing air containing the chemical as well as directly by using products that contain these chemicals.

Conclusion

The Priority Chemical Candidate list generated here results from a scientifically supportable method for prioritizing Maine Chemicals of High Concern for further action, based on the methodology outlined in the Maine Kid-Safe Products Act itself. The steps used to generate the list were designed to be easily understandable and reproducible. The chemicals included in this list have all been found in humans, with an emphasis put on potential childhood exposure or detection. This list includes chemicals from many classes, covering a wide range of uses. This list is meant to serve to indicate chemicals that are known to be or may be emergent health risks to children in Maine and for which priority action may be warranted.

Biographical Information

The Consortium for Environmental Risk Management (CERM) is an environmental science/regulatory consulting firm specializing in the use of the US EPA Pollution Prevention Framework tools and methodology for screening chemicals for hazard and risk in the absence of complete data. The company has more than 30 years collective experience in chemical hazard and risk evaluation, hazard and risk communication, new chemical regulatory issues, organic chemistry and computational environmental science. CERM has worked extensively with the US EPA and chemical industry stakeholders in reviewing chemicals for hazard and risk in support of the US EPA's Sustainable Futures Initiative, as well as outreach and training related to the initiative.

Dr. Peter Ranslow, CERM's Director of Risk Assessments, is the scientific lead for this project. Dr. Ranslow received his Ph. D. in Organic Chemistry from Colorado State University. He joined CERM in 2003 to work with the US EPA and chemical industry stakeholders in the use of the Pollution Prevention methodology and the Sustainable Futures Initiative. He is also involved with training others on the use of these tools, both domestically and abroad. While with CERM, Dr. Ranslow has gained extensive experience using these, and other, tools in the hazard and risk assessment of industrial chemicals. Peter is a Maine native who has moved back to the state.

Dr. Elizabeth Becker, CERM's Manager, Technical Services, assisted in the preparation and documentation steps for this project. Dr. Becker received her Ph. D. in Organic Chemistry from the University of Cincinnati and, following a career in the food and pharmaceuticals industry, joined CERM in 2002. She has utilized the EPA Pollution Prevention tools to conduct screening level hazard and risk assessment for both new and existing chemicals. Elizabeth is experienced in the requirements for the registration of safe chemicals as well as the utilization of appropriate chemicals and plastics for both food contact and health care applications.

References:

[1] Maine Public Laws, Chapter 643: http://www.mainelegislature.org/ros/LOM/LOM123rd/123S1/PUBLIC643.asp
[2] Maine Chemical of High Concern list: http://www.maine.gov/dep/oc/safechem/highconcern/#_msocom_1
[3] Maine Safer Chemicals in Consumer Products and Services website: http://www.maine.gov/dep/oc/safechem/index.htm
[4] Fourth National Report on Human Exposure to Environmental Chemicals, 2009 (CDC NHANES Report, 4th). Department of Health and Human Services Centers for Disease Control and Prevention: http://www.cdc.gov/exposurereport/
[5] Body of Evidence: A Study of Pollution in Maine People. June, 2007. Alliance for a Clean and Healthy Maine. http://www.cleanandhealthyme.org/BodyofEvidenceReport/tabid/55/Default.aspx
[6] Body Burden Study: Toxic Exposures in the Green Mountain State. Steven P. Dickens, Primary Author. The Alliance for a Clean and Healthy Vermont. Sponsor, River Network , www.rivernetwork.org.
[7] Mind, Disrupted: *How toxic chemicals may affect how we think and who we are. February, 2010.* The Learning and Developmental Disabilities Initiative (LDDI), Sponsor. http://www.minddisrupted.org/
[8] Fire Retardants in Toddlers and Their Mothers. September, 2008. Environmental Working Group. http://www.ewg.org/reports/pbdesintoddlers
[9] Teen Girls' Body Burden of Hormone-Altering Cosmetic Chemicals, Adolescent Exposures to Cosmetic Chemicals of Concern. September, 2008. Environmental Working Group. http://www.ewg.org/book/export/html/26953
[10] Pollution in People: A Study of Toxic Chemicals in Washingtonians. May, 2006. A Toxic-Free Legacy Coalition Report. http://pollutioninpeople.org/
[11] Is It In Us? Chemical Contamination of Our Bodies. A report from the Coming Clean Body Burden Workgroup and the Commonweal Biomonitoring Resource Center, 2010. http://www.isitinus.org/home.php
[12] A Present for Life, hazardous chemicals in umbilical cord blood. September, 2005. Greenpeace & WWF. http://www.greenpeace.org/eu-unit/press-centre/reports/a-present-for-life
[13] Earliest Exposures: A Research Project by Washington Toxics Coalition, study completed in collaboration with the Commonweal Biomonitoring Resource Center and the Toxic Free Legacy Coalition. November, 2009. Author: Erika Schreder. http://watoxics.org/publications/earliest-exposures
[14] Additional biomonitoring studies that were reviewed, but not used as lead references include: a) Commonweal Study "Taking it All In," http://www.commonweal.org/programs/brc/Taking_It_All_In.html; b) PANNA Air/Chlorpyrifos studies, http://www.pesticidereform.org/downloads/Biodrift-Summary-Eng.pdf; c) Generationsx - an EU study, http://www.panda.org/what_we_do/how_we_work/policy/wwf_europe_environment/news/?uNewsID=23635; d) WWF: ContamiNation - a UK blood study, http://www.wwf.org/filelibrary/pdf/biomonitoringresults.pdf; e) Physicians' Health Care, http://www.psr.org/resource/hazardous-chemicals-in-health.html; f) EWG Cord Blood in Minority Newborns , http://www.ewg.org/minoritycordblood.home; g) EWG Body Burden - The Pollution in People, http://archive.ewg.reports/bodyburden1/es.php; h) Pollution in 5 Extraordinary Women, http://www.ewg.org/report/Pollution_in_5_Extraordinary_Women
[15] Dinglasan, Mary Joyce A; Ye, Yun; Edwards, Elizabeth A. and Mabury, Scott A. Fluorotelomer Alcohol Biodegradation Yields Poly- and Perfluorinated Acids. Envir. Sci.Technol. 38 (10), 2004, pp 2257-2264.
[16] a) Rhoads, Kurt R.; Janssen, Elisabeth M.-L.; Luthy, Richard G.; Criddle, Craig S. Aerobic Biotransformation and Fate of N-Ethyl Perfluorooctane Sulfonamidoethanol (N-EtFOSE) in Activated Sludge. Envir. Sci.Technol. 42 (8), 2008, pp 2873-2878; b) Report of the Persistent Organic Pollutants Review Committee on the work of its second meeting – Addendum: Risk Profile of Perfluorooctane Sulfonate. November, 2006. United Nations Environment Programme. http://www.pops.int/documents/meetings/poprc_2/meeting_docs/report/POPRC-2%20rep%20add5.pdf; c) Canadian Environmental Protection Act 1999: Environmental Screening Assessment Report on Perfluorooctane Sulfonate, Its Salts and Its Precursors that Contain the C8F17SO2 or C8F17SO3 Moiety. April, 2004. Environment Canada. http://www.ec.gc.ca/ceparegistry/documents/subs_list/PFOS/PFOS_P1.cfm
[17] US CDC Agency for Toxic Substances and Disease Control Registry (ATSDR): http://www.atsdr.cdc.gov/
[18] *Phthalates and Cumulative Risk Assessment: The Task Ahead*, study by the National Academies of Science National Research Council. December, 2008: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=202508

[19] Peters, Rudd J.D. TNO Report on Phthalates and Artificial Musks in Perfumes. January, 2005: http://www.greenpeace.org/raw/content/international/press/reports/phthalates-and-artificial-musk.pdf
[20] US EPA Design for the Environment program: http://www.epa.gov/dfe/
[21] New York State Executive Order 4, Green Procurement Chemical Avoidance List: http://www.ogs.state.ny.us/EO/4/Docs/GreenProcurementChemicalPriorityList_20091220.xls
[22] Oregon Department of Environmental Quality, Senate Bill 737 Implementation: Addressing Priority Persistent Pollutants in Oregon's Water: http://www.deq.state.or.us/wq/sb737/
[23] California Office of Environmental Health Hazard Assessment, Proposition 65: http://oehha.ca.gov/prop65.html
[24] US EPA Existing Chemical Action Plans: http://www.epa.gov/oppt/existingchemicals/pubs/ecactionpln.html
[25] Washington State Reporting List of Chemicals of High Concern to Children: http://www.ecy.wa.gov/programs/swfa/cspa/pdf/ChemicalReportingList.pdf
[26] US EPA Technology Transfer Website: http://www.epa.gov/ttn/atw/hlthef/antimony.html
[27] Maine Geologic Survey Website Arsenic Information: http://www.maine.gov/doc/nrimc/mgs/about/water-pest.htm
[28] Pritchard, Justin; Donn, Jeff. US Agency Goes After Cadmium in Children's Jewelry. January, 2010. Associated Press.
[29] Maine State Department of Environmental Protection, Bureau of Remediation and Waste Management Lead Information Website: http://www.maine.gov/dep/rwm/lead/
[30] Maine State Department of Environmental Protection Mercury Information Website: http://www.maine.gov/dep/mercury/
[31] PFCs: Global Contaminants. April, 2003. Environmental Working Group: http://www.ewg.org/reports/pfcworld
[32] EPA Method 1614, Brominated Diphenyl Ethers in Water Soil, Sediment and Tissue by HRGC/HRMS. August, 2007. EPA-821-R-07-005.