A Clean Production Action Report

Chemical Footprint of Products Commonly Used in Pediatrics Departments

Mark S. Rossi, PhD and Wanda Ratliff, MS

Chemical Footprint of Products Commonly Used in Pediatric Patient Rooms

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Clean Production Action is a solutions focused non-profit organization that advances safer alternatives to hazardous chemicals through its BizNGO, Chemical Footprint Project (CFP), and GreenScreen® programs.

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Executive Summary

For medical products that contain *chemicals of high concern*, are there alternatives in the marketplace?

Executive Summary

Hazardous chemicals in products and supply chains are catalyzing health care organizations, retailers, and other businesses to ask their suppliers whether their products and manufacturing operations use these chemicals and whether safer alternatives are available.[1] This study was designed to assess the chemical footprint of products commonly found in a hospital pediatric patient room. Pediatrics was chosen for evaluation because of the well-recognized greater sensitivity of children to exposure to toxic chemicals than adults.

"Chemical footprinting" is the process of evaluating the presence of hazardous chemicals in products, manufacturing processes, supply chains, and/or packaging.[2] Chemical footprints provide baseline data, be they the number of chemicals of high concern in products and/or their mass, for evaluating performance and benchmarking progress away from hazardous chemicals to safer alternatives.[3] This chemical footprint study focused on products commonly used in a pediatric patient room that have the potential for moderate or higher patient exposure because they are in the body (e.g., nasogastric and endotracheal tubes), on the body (e.g., bracelets, soaps, or tape), or used frequently around the body (e.g., cleaning and disinfecting products used in patient rooms). For this study, the chemical footprint of a pediatric product was defined by the presence of chemicals of high concern in a product. This study demonstrates how to chemical footprint products in health care and how chemical footprinting can inform purchasing decisions in health care.

This study demonstrates how to chemical footprint products in health care and how chemical footprinting can inform purchasing decisions.

Method

The chemical footprinting of products in a pediatric patient room involved:

- Specifying the list of chemicals of high concern (CoHCs). These chemicals represent the "chemical footprint" of a product.
- Developing criteria for prioritizing products based on potential for exposure.
- Inventorying products commonly used in a pediatric patient room and developing a list of priority products based on potential for patient exposure.
- Confirming product details, including supplier catalog numbers, with purchasing staff at two hospitals.
- Sending surveys to 62 suppliers requesting information on CoHCs in 358 priority products.

Three health care organizations participated at various levels in this study. One health care organization and its group purchasing organization participated in all aspects of the study. Another health care organization participated in collecting information by telephone interviews with pediatric nursing, procurement, and environment, health, and safety (EH&S) staff; identifying priority products; sending the survey to suppliers; and reviewing the responses. A third health care organization hosted an on-site survey of products in a pediatric patient room that included interviews with pediatric nursing,

Over half of the 253 pediatric products evaluated did not contain chemicals of high concern (CoHCs).

procurement, and environment, health, and safety (EH&S) staff.

Pediatric products with moderate to higher potential exposure were identified and suppliers were surveyed concerning CoHCs in their products. For this study, CoHCs were defined as those substances with potential to cause adverse health effects to people or the environment, and have been prioritized for reduction by health care organizations. CoHCs included the carcinogenic and reproductive/developmental toxicants on the California Proposition 65 list; latex; and persistent, bioaccumulative, and toxic (PBT) substances (see Section 2 for details).

The survey was sent to 62 suppliers representing 358 products from two health care organizations, with 50 suppliers responding with answers for 253 products. The data were combined into one dataset to protect the anonymity of the health care organizations and their suppliers. Due to the number of products for which suppliers did not reply (155 products had no reply), the combining of the products into a single data set did not result in an overstatement of the chemical footprint of a representative patient room. Note the data provided below are illustrative, not definitive, of the chemical footprint of products in a pediatric patient room.

Findings

Fifty suppliers replied with data on 253 products commonly found or used in a pediatric patient room. The products covered four categories of products: medical supplies (185 products), personal care products (50 products), furnishings (11 products), and cleaning or disinfecting products (seven products). Over half of the 253 pediatric products evaluated did not contain chemicals of high concern (CoHCs). Specifically, 114 products contained CoHCs (45%) and 139 products did not contain CoHCs (55%) (see Figure ES-1).

In the Medical Supplies category, IV products, enteral feeding products, respiratory therapy products, and catheters had the greatest number of products containing CoHCs. These products accounted for 82% of the medical supplies with CoHCs (see Figure ES-2).

Reflecting the disposable nature of single-use medical supplies, the primary CoHCs found in this category were polyvinyl chloride (PVC)

Reflecting the disposable nature of single-use medical supplies, the primary CoHCs found in this category were PVC plastic, phthalates, BPA, and other Prop 65 chemicals.

FIGURE ES-1. **Number of Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**

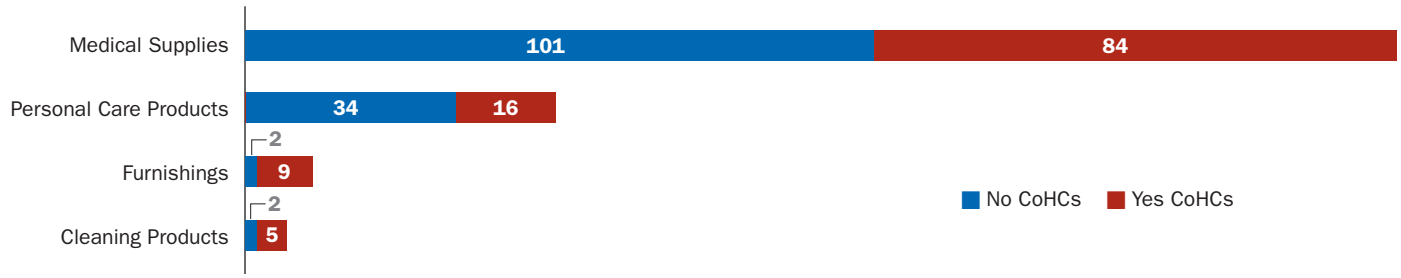
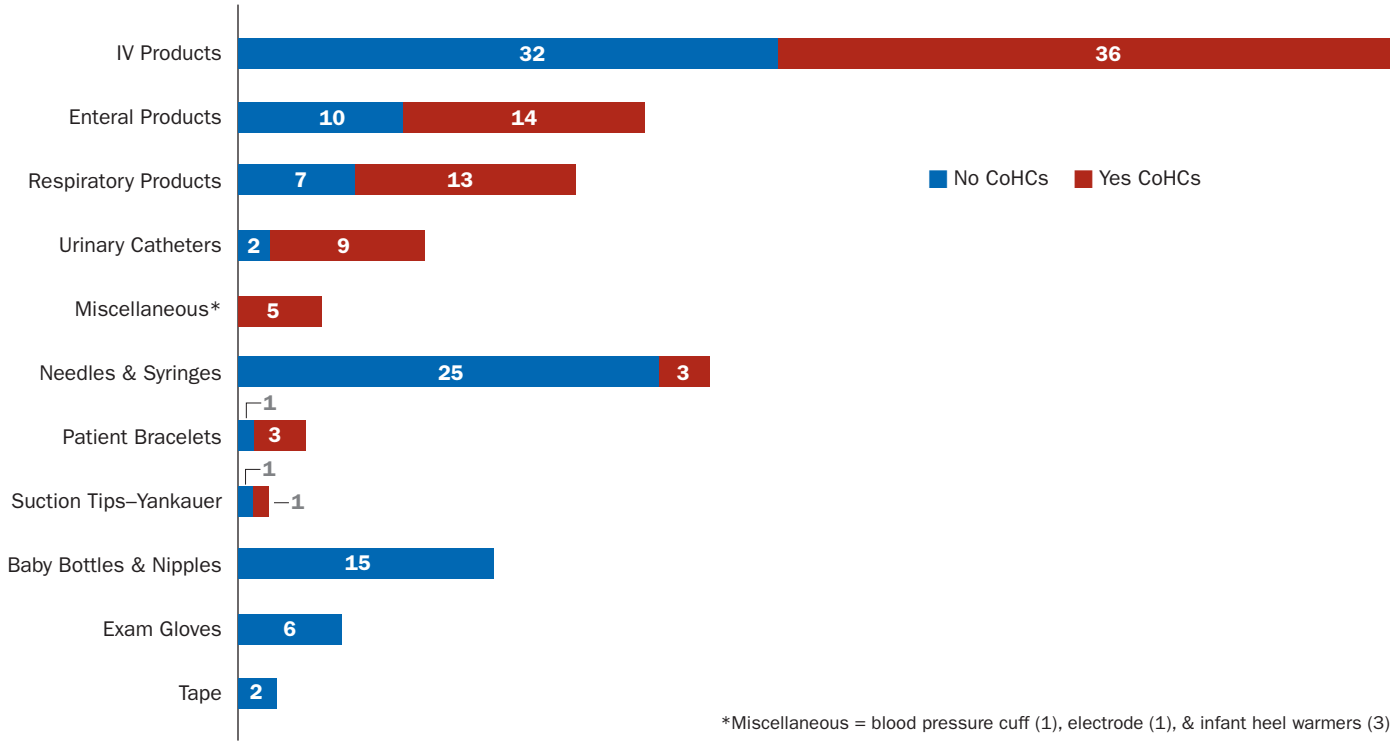


FIGURE ES-2. **Number of Medical Supplies Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



*Miscellaneous = blood pressure cuff (1), electrode (1), & infant heel warmers (3)

plastic, phthalates (DIDP, DBP, and DEHP),[4] Bisphenol A (BPA), and other California Prop-osition 65 (Prop 65) chemicals, including monomers and solvents. These four chemicals/chemical classes accounted for 91% of the CoHCs reported in medical supplies (see Figure ES-3, p. 4).

Of the 63 medical supply products with PVC, 37 contained phthalates, five contained BPA, three contained antibacterials/antimicrobials, and 20 contained other Prop 65 chemicals including monomers and solvents. Note that some PVC medical supplies contained multiple CoHCs; for example, both phthalates and Prop 65 monomers and solvents.

Medical supplies with the greatest number of PVC- and phthalate-containing products were: a) IV solutions with 12 products; b) respiratory therapy masks with seven products; c) urinary catheters with five products; and d) needles and syringes with three products. For these four categories of medical supplies, all 27 of the PVC products contained phthalates. The IV solutions contained the phthalate DBP, along with a range of Prop 65 monomers and solvents. All of the respiratory therapy products with CoHCs contained PVC and the phthalate DEHP. The urinary catheters contained DEHP (four products) and unspecified phthalates (one product). The needles and syringes contained DEHP at approximately 200 parts per million (ppm) as a mixture or contaminant with a non-phthalate plasticizer.

The personal care category included 50 products with 34 (68%) of the products containing no CoHCs and 16 (32%) of the products containing one or more CoHC (see Figure ES-4, p. 4). Lotions,

IV products, enteral feeding products, respiratory therapy products, and catheters were the medical supplies with the greatest number of products containing CoHCs.

ointments, lip balms, diapers, shampoo caps, and personal care bags—along with the majority of skin wipes and oral care products—did not contain CoHCs. The dominant CoHCs reported in personal care products were antibacterials and antimicrobials in soaps and washes, hand sanitizers, and skin wipes (12 products); and latex (six products). Other CoHCs reported in personal care products were phthalates in hand sanitizers and the Prop 65 chemical, benzophenone in soap.

For every personal care product that contained a CoHC, there was at least one product that did not contain a CoHC. This finding highlights that health care organizations can procure functionally appropriate personal care products that contain no CoHCs.

Reflecting the demands of protecting against bacterial and viral infections in health care, surface disinfectants and germicidal wipes are likely to contain CoHCs. The three surface

FIGURE ES-3. **Chemicals of High Concern (CoHCs) in Medical Supplies Commonly Used in Pediatric Patient Rooms and the Number of Products that Contained Them**

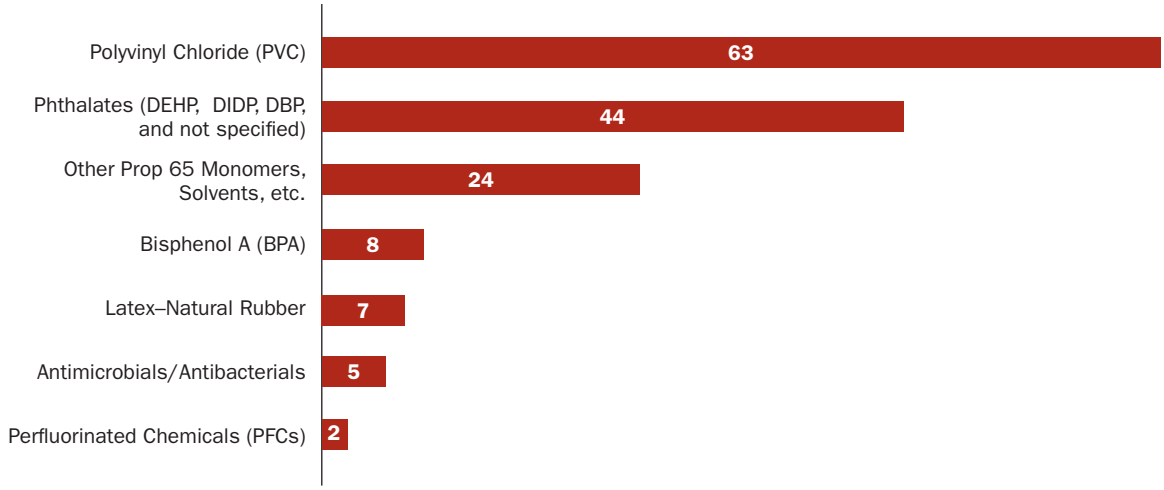
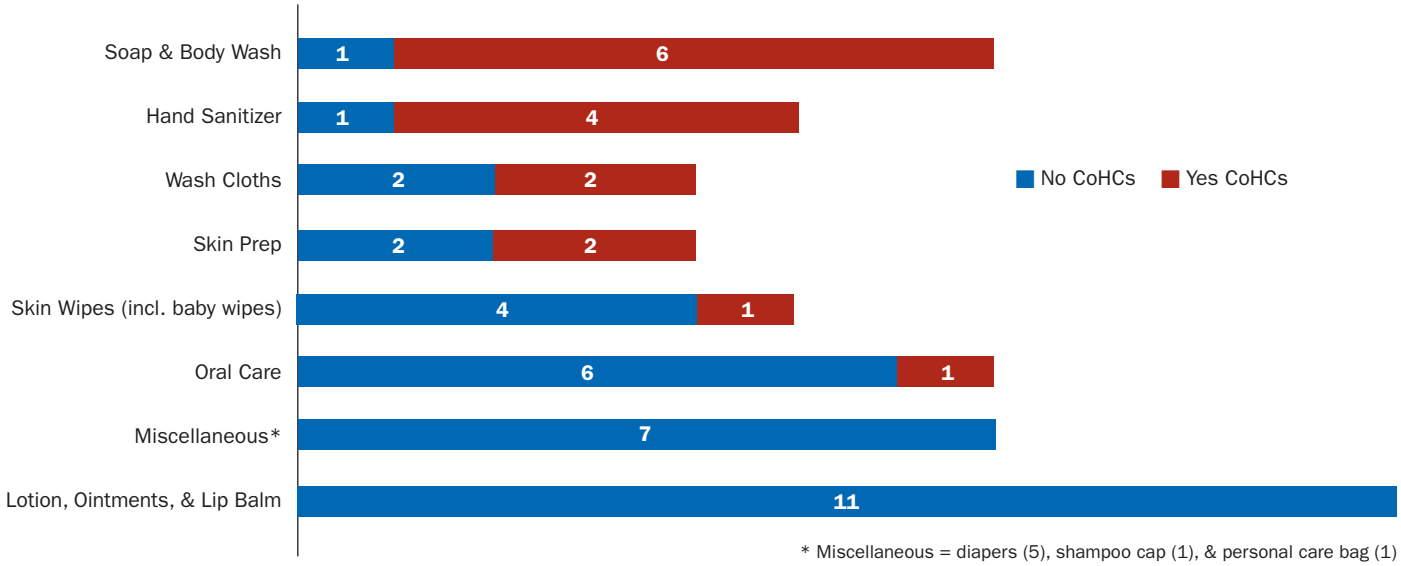


FIGURE ES-4. **Number of Personal Care Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



* Miscellaneous = diapers (5), shampoo cap (1), & personal care bag (1)

Photo courtesy of Dignity Health

disinfectants included in this survey all contained antibacterials/antimicrobials, and a cloth used with the disinfectants included the Prop 65 chemical, titanium dioxide. Similarly, both germicidal wipes contained antibacterials/antimicrobials as well as latex. Only the general purpose cleaners did not contain any CoHCs, including no antibacterials and antimicrobials.

The furnishings category included cribs, crib mattresses, beds, bed mattresses, and other patient furniture. In total, 11 products were included in the survey, with all of the products except crib mattresses containing CoHCs. All four cribs contained PVC and antibacterials/antimicrobials, while the crib mattresses contained no CoHCs. The other patient room furniture, stool and overbed table, included PVC (overbed table), BPA (stool), halogenated flame retardants (overbed table), heavy metals (stool and overbed table), and other Prop 65 chemicals (overbed table).

Patient beds were the most complex product included in the entire survey, and the only product that contained electrical equipment. Not surprising, given their complexity, patient beds included the greatest number of CoHCs, including: PVC; halogenated and non-halogenated flame retardants; heavy metals; persistent, bioaccumulative and toxic (PBT) substances; substances on the European Union Restriction of Hazardous Substances (RoHS) Directive; BPA; phthalates; and Prop 65 solvents. Bed mattresses also contained a wide range of CoHCs, including: PVC, halogenated and non-halogenated flame retardants, heavy metals, perfluorinated compounds (PFCs), BPA, phthalates, and other unspecified Prop 65 chemicals.

Overall, the dominant CoHCs identified in pediatric products were PVC, phthalates, antibacterials/antimicrobials, Prop 65 monomers

For every personal care product that contained a CoHC, there was at least one equivalent product that did not contain a CoHC.

and solvents, latex, and BPA. Together these six chemicals/chemical classes accounted for 85% of the reported instances of CoHCs in pediatric products. **An interesting finding is that antibacterials and antimicrobials are being added to a range of products that come into patient skin contact, including IV arm restraints, patient bracelets, cribs, and wash cloths.**

A number of products featured one or more supplier selling one product with CoHCs while another supplier sold a comparable product without CoHCs:

- enteral feeding tubes: some contained PVC while others contained no CoHCs;
- IV arm restraints: some contained PVC while others contained no CoHCs;
- IV catheters: some contained BPA or PVC while others contained no CoHCs;
- skin prep: some contained latex while others contained no CoHCs;
- all of the following products featured some suppliers selling the product with antibacterials/antimicrobials and others selling the equivalent product with these CoHCs:
  - soaps and body washes,
  - hand sanitizers,
  - patient bracelets,
  - wash cloths, and
  - skin wipes.

These products represent potentially quick opportunities for substitution. For other products containing CoHCs, alternatives may be available but will require further research.

Opportunities for Next Steps

This first chemical footprint of products used in pediatric patient rooms demonstrated how health care organizations can measure their chemical footprint at the departmental level and identified products that contain or do not contain CoHCs. For the participating organizations it provides a baseline chemical footprint for a pediatric patient room—the number of products that contain CoHCs. For other health care organizations, it provides an indicator of the types of products likely to contain CoHCs on their shelves. With chemical footprint data in hand, health care organizations can measure their progress in reducing their footprint.

For the 114 products that contained CoHCs the question is, are there alternatives on the market that do not contain CoHCs?

For the 114 products that contained CoHCs the question is, are there alternatives on the market that do not contain CoHCs? Specific product categories in need of research on alternative products are:

- IV products (including administration/extension sets, connectors, and tubing),
- enteral and total parenteral nutrition (TPN) products,
- catheters,
- blood tubing,
- respiratory therapy products,
- personal care products (skin wipes, hand sanitizers, soaps/body washes), and
- cleaning products (general purpose/facility cleaners; surface cleaners).

Given the general connections between PVC, phthalates, and other Prop 65 chemicals, health care organizations could take a major step towards reducing their chemical footprint by avoiding PVC-based products where feasible.

A second research need is for the product categories where some products contained CoHCs and other similar products did not contain CoHCs. The research question: are the products meeting the same specifications and functional uses? The next research step for these products is to gather data on the specific end uses of those products and determine whether they can be substituted without offsetting required levels of performance.

With alternative products identified that do not contain CoHCs, health care organizations will have the chemical information they need to replace the products. With data on number of products with CoHCs and information on the availability of safer alternatives, health organizations will be prepared to engage suppliers in

evaluating, selecting, and purchasing alternative products that do not contain CoHCs while meeting performance requirements and price points. A step along this path would be to set goals for reducing the chemical footprint by percent or number of products per year.

Measuring and reducing chemical footprints requires the collection, management, and analysis of data that are not the expertise of most health care organizations. The following actions would simplify the process for all health care organizations interested in tracking and reducing CoHCs in products:

- ***CoHCs:*** Agree to a common list of CoHCs for health care.
- ***Reporting:*** Require suppliers to (or prefer suppliers that) report chemical ingredients to a common template.
- ***Certification:*** Use a third-party certification of products, such as GreenScreen® Certified, that identifies products that do not contain CoHCs. Such a certification would greatly simplify communication between suppliers and health care organizations on the presence or absence of CoHCs in products.

Together suppliers and health care organizations can advance the use of green chemistries that are safe and healthy for people and the planet.

The chemical footprinting of products commonly used in pediatrics reveals a clear set of next steps that will enable health care organizations to reduce known chemicals of concern to human health and the environment in products they use every day beyond what is required by regulations. Additionally the research highlights the importance of suppliers knowing the chemicals in their products and putting into place policies and procedures to identify and reduce CoHCs. Together suppliers and health care organizations can advance the use of green chemistries that are safe and healthy for people and the planet.

Bringing Chemical Footprinting to Healthcare

CHAPTER 1

Bringing Chemical Footprinting to Health Care

Chemicals are the foundation of our materials economy. Part of all products, be they liquid, gas, or solid, chemicals are the building blocks of the products we use every day. Yet, all chemicals are not created equal. Some are inherently safe while others are inherently hazardous to human health or the environment. Water, known by the chemical formula H_2O, is an inherently safe chemical—we drink it, bathe in it, and it comprises approximately 60% of our body weight. Other chemicals are not so healthy or essential to life.

Di(2-ethylhexyl)phthalate (DEHP) is an example of an inherently hazardous chemical that is widely found in health care. The primary end use of DEHP is to make polyvinyl chloride (PVC or "vinyl") plastic flexible. Technically referred to as a "plasticizer," DEHP can be found in PVC plastic products used in health care. Animal studies reveal DEHP to be toxic to the reproductive system, causing adverse effects to the testes and liver.[5] The U.S. National Toxicology Program concluded in 2006 that "There is serious concern that certain intensive medical treatments of male infants may result in DEHP exposure levels that adversely affect development of the male reproductive tract." [6] In 2002, the U.S. Food and Drug Administration (FDA) released a public health notification concerning DEHP in PVC medical devices and pinpointed concerns with DEHP exposure to the male fetus, male neonate, and peripubertal (time around puberty) male during procedures posing the highest risk of exposure to DEHP, including total parenteral

nutrition (TPN) in neonates and enteral nutrition in neonates and adults.[7] France restricted the use of DEHP in certain medical devices in 2015.[8]

The presence of hazardous chemicals such as DEHP in products is leading health care organizations, retailers, and other purchasers to ask their suppliers whether the products they purchase contain hazardous chemicals and to prefer products made with inherently safer chemicals.[9] Business and health care leaders are striving to know the extent to which hazardous chemicals are in the products they purchase and use every day. The identifying, tracking, and measuring of hazardous chemicals in products is part of a new trend called "chemical footprinting."[10]

"Chemical footprinting" is the process of evaluating the presence of hazardous chemicals in products, manufacturing processes, supply chains, and/or packaging.

"Chemical footprinting" is the process of evaluating the presence of hazardous chemicals in products, manufacturing processes, supply chains, and/or packaging.[11] Chemical footprints provide data, be they the number of chemicals of high concern in products and/or their mass, for evaluating performance and benchmarking progress away from hazardous chemicals to safer alternatives.[12]

This study was designed to assess the chemical footprint of products commonly found in a hospital pediatric patient room. Pediatrics was chosen for evaluation because of the well-recognized greater sensitivity of children to exposure to toxic chemicals than adults. As the environmental health researchers Philip Landrigan and Lynn Goldman summarized: "early life exposures to toxic chemicals are important causes of disease and dysfunction in children and also in adults, and that diseases caused by chemicals can successfully be prevented, thus saving lives, enhancing the quality of life, reducing health care and education costs, and increasing national productivity."[13]

In this study the chemical footprint is the products that contain chemicals of high concern (CoHCs) in a pediatric patient room. By identifying hazardous chemicals in products used in a pediatric patient room, chemical footprinting can help health care providers identify products to avoid (those that contain hazardous chemicals) and prefer (those that do not contain hazardous chemicals). While the level of exposure to hazardous chemicals in any one product may be quite small, the cumulative effect of constant exposure to small levels of hazardous chemicals could cause adverse health effects, especially for children. As researchers from the Emma Children's Hospital in Amsterdam concluded, the "increased knowledge of the greater sensitivity of the unborn baby, the infant and the child, has led to general recognition that a higher degree of precaution is now needed in regulating for multiple stressors on the young."[14] Thus avoiding hazardous chemicals in pediatric products represents a preventative action, preventing the potential for adverse effects from quite small but cumulative levels of exposure to known hazardous chemicals among vulnerable populations.

This chemical footprint study focused on products commonly used in a pediatric patient room that have the potential for patient exposure because they are in the body (e.g., nasogastric tubes and various catheters), on the body (e.g., bracelets, soaps, or tape), or used frequently around the body (e.g., cleaning and disinfecting products used in patient rooms). This study provides both an example of how to chemical footprint products in the health care setting and how chemical footprinting can be used to inform purchasing decisions in health care.

2 Method for Chemical Footprinting Products Used in Health Care

CHAPTER 2

Method for Chemical Footprinting Products Used in Health Care

The chemical footprinting of products in a pediatric room involved:

- Specifying the list of chemicals of high concern (CoHCs). These chemicals represent the "chemical footprint" of a product.
- Developing criteria for prioritizing products based on potential for exposure.
- Inventorying products commonly used in a pediatric patient room and developing a list of priority products based on potential for patient exposure.
- Confirming product details, including supplier catalog numbers, with purchasing staff at two hospitals.
- Sending surveys to 62 suppliers requesting information on CoHCs in 358 priority products.

Three health care organizations participated at various levels in this study. One health care organization and its group purchasing organization participated in all aspects of the study. Another health care organization participated in collecting information by telephone interviews with pediatric nursing, procurement, and environment, health, and safety (EH&S) staff; identifying priority products; sending the survey to suppliers; and reviewing the responses. A third health care organization hosted an on-site survey of products in a pediatric patient room that included interviews with pediatric nursing, procurement, and environment, health, and safety (EH&S) staff. Specific products were identified and suppliers were surveyed concerning CoHCs in products identified in pediatric rooms in two of the three health care organizations.

Photo courtesy of Dignity Health

2.1 Chemicals of High Concern (CoHCs) and Potential for Exposure

This study surveyed suppliers on the presence of 12 chemicals/classes of CoHCs in their products. The 12 chemicals/classes of CoHCs were identified on the basis of similar criteria that have been applied in the health care sector, including Practice Greenhealth's Standardized Environmental Questions for Medical Products[15] and Kaiser Permanente's Sustainability Scorecard for Medical Products.[16] The rationale for this decision was that since many suppliers have been socialized to these chemicals by Practice Greenhealth and other health care organizations, it would be easier for suppliers to answer a survey concerning the presence of these chemicals in their products. The 12 chemicals/classes of CoHCs and the thresholds for reporting the chemicals in products are as follows:

1. Substances listed on the European Union's Restriction of Hazardous Substances (EU RoHS) Directive for Electrical and Electronic Equipment and above the regulatory requirements specified by RoHS.[17]
2. Bisphenol A (BPA): homogenous material in the product contains greater than or equal to 1,000 ppm of intentionally added BPA and related structural or functional analogues.[18]
3. Polyvinyl Chloride (PVC): product contains any PVC.
4. Bromine- and chlorine-based compounds: homogenous material in the product contains greater than or equal to 1,000 ppm of bromine and chlorine-based compounds.[19]
5. Phthalates (including DEHP and nine other phthalates): homogenous material in the product contains greater than or equal to 1,000 ppm of phthalates.[20]
6. California Proposition 65 (Prop 65) chemicals: the product contains any intentionally added chemical listed under Prop 65.
7. Antimicrobial and antibacterial agents: the product contains intentionally added antimicrobial/antibacterial agents to reduce surface pathogens.
8. Persistent, bioaccumulative, and toxic (PBT) chemicals: homogenous material in the product contains greater than or equal to than 1,000 ppm of a PBT.[21]
9. Non-halogenated flame retardants: non-electronic homogeneous material contains greater than or equal to 1,000 ppm of any chemical or chemical compound for which the functional use is to resist or inhibit the spread of fire, including but not limited to phosphorous- and nitrogen-based chemicals.
10. Metals: product contains mercury, lead, cadmium, or organotin compounds (see endnote for specified thresholds).[22]
11. Perfluorinated chemicals (PFCs): product contains stain- or water-repellant treatments that contain a perfluorinated compound.
12 Latex: product contains latex. Latex is included as a CoHC because of the concerns with latex allergy in the health care sector, which can in the most severe cases lead to anaphylactic shock.

The 12 chemicals/classes of CoHCs were identified on the basis of similar criteria that have been applied in the health care sector, including Practice Greenhealth's Standardized Environmental Questions for Medical Products and Kaiser Permanente's Sustainability Scorecard for Medical Products.

These 12 chemicals/chemical classes were adopted as the CoHCs list for this study. This list of chemicals includes close to 1,000 chemicals that are carcinogens, reproductive toxicants, endocrine disruptors, or PBTs.

"Pediatric products" include products used in pediatric patient (0-18 years of age) rooms. To determine the potential for patient exposure to a product, the following criteria were used:

- Higher potential for exposure: products and/or their packaging (for example, saline solution in plastic IV bag) have the potential for internal bodily contact (including oral, inhalation, ingestion, intravenous, and enteral). Examples of products with higher potential for pediatric patient exposure included IV lines and bags,

feeding tubes, nasal cannula, and baby bottle nipples.

- Moderate potential for exposure: products and/or their packaging have the potential for external bodily contact (dermal exposure) or inhalation and frequent or extended duration exposure. Examples of products with moderate potential for pediatric patient exposure included hand soap, skin sanitizers, diapers, and surface disinfectants used in patient rooms.
- Lower potential for exposure: products and/or their packaging have the potential for only external bodily contact (dermal), infrequent exposure, and short duration exposure. Examples of products with lower potential for exposure included IV pumps, patient monitor screens, blood collection vials, bedpans, and urine specimen containers.

Using these exposure criteria, the study identified and included products with moderate to higher potential for pediatric patient exposure, while those with lower potential exposure were identified and excluded. Input from nursing, procurement, and EH&S staff was critical to understanding products of greatest use and potential for moderate or more exposure.

Products excluded from the inventory were food products, pharmaceuticals, surgically implanted devices, built-environment products (for example, flooring, wall finishes, wall guards, casework, ceiling materials, windows and other fixed/non-moveable items), and products not related to direct patient treatment (for example, office supplies typically found at a nurses station). Fixed built environment products were excluded because the focus of this research was on products that procurement staff could address in the near term, versus requiring room renovations. Pharmaceuticals and surgically implanted devices were excluded because these product selections are clinical decisions. Food products were excluded because food selection varies widely across health care facilities and patient dietary needs.

2.2 Inventory of Products Commonly Used in Pediatric Patient Rooms and List of Priority Products

To inventory products commonly used in pediatric patient rooms we reviewed pediatric department purchasing records from two hospitals; conducted on-site inventories at two hospitals; and interviewed nursing, procurement, and

EH&S staff at three hospitals (two on-site and one by telephone).

First, we reviewed the department of pediatrics purchasing records from one health care organization. From these records, five general product categories were identified for inventory:

- personal care products, including hand sanitizers, shampoos, toothpastes, and wash cloths;
- cleaning and disinfectant products used on a daily basis to clean or disinfect surfaces in patient rooms;
- furnishings that can be moved in and out of patient rooms including beds, cribs, and mattresses;
- medical supplies including enteral feeding tubing, intravenous (IV) administration sets, and nasal cannula; and
- medical equipment including patient monitors and IV pumps.

These five categories included thousands of individual products.

Second, we conducted on-site visits to two pediatric departments. We inventoried supply and patient rooms, and interviewed pediatric nursing, procurement, and EH&S staff to identify products with the greatest potential for patient and staff exposure. At one hospital we completed an in-depth inventory of products commonly used and found in a pediatric patient room.

The on-site visits resulted in the elimination of one product category, durable medical equipment, due to lower potential for patient exposure. The medical equipment category had the lowest potential for direct patient exposure among all the products found in the patient rooms. Since medical equipment may off-gas hazardous chemicals from the housings (such as flame retardants) and wires (such as phthalates), the hazardous chemicals in these products is worth follow-up research.

After the removal of the medical equipment category, approximately 1,300 products remained on the product inventory. The list was further reduced when products were screened

for their potential for moderate or higher potential for exposure. Using the priority product list from one health care organization, a second health care organization used annual usage purchase data and discussion with department of pediatrics staff to identify 75 products with moderate or higher potential for exposure. In total, we identified 358 priority products from 62 suppliers.

2.3 Supplier Survey

We worked with two health care organizations and a group purchasing organization to survey suppliers on the presence or absence of CoHCs (see Section 2.1 for the list of CoHCs) in their products. The survey was sent in Microsoft Excel format and included instructions, a survey sheet for supplier responses, and a list of abbreviations. The instructions sheet outlined the instructions for completing the survey. The instructions included specific criteria for each of the 12 chemicals/classes of CoHCs. In the survey, an answer of "no" meant the product did not meet the criteria and "yes" meant the product met the criteria. For example, a supplier would answer "no" if the product contained the phthalate DEHP because it did not meet the phthalate-free goal for products or "yes" if the product did not contain any phthalates because it met the phthalate-free goal.

Suppliers were also asked to provide a description of the product and to answer two additional questions: 1) is the product designed or sized for pediatric use; and 2) did the supplier conduct an assessment to identify the presence of all of the CoHCs in the product. In total the survey had 19 fields: manufacturer name, manufacturer catalog number, manufacturer product description, extended manufacturer product description, specified use in a department of pediatrics, 12 chemicals/classes of chemicals, list of Proposition 65 chemicals specified by Chemical Abstract Services Registry Number (CASRN) if present in the product, and chemical inventory.

The same survey format was sent to every supplier, though each supplier received a specific list of products that was unique to itself. Products were specified by product description and manufacturer catalog number, and if that information was missing by model name and number. A letter from the health care organization, or health care organization and group purchasing organization, accompanied the survey, explained the project, and authorized us to collect the product information on their behalf. The letter and survey were sent to 62 suppliers representing 358 products.

Critical data needs in assessing the chemical footprint of products in health care organizations are: a) accurate information on the products in use; and b) having the most up-to-date supplier name, product catalog number, and contact information for each product.

Critical data needs in assessing the chemical footprint of products in health care organizations are: a) accurate information on the products in use; and b) having the most up-to-date supplier name, product catalog number, and contact information for each product. Lessons learned in data collection were the importance of both "bottom-up" and "top-down" data collection methods. "Bottom-up" data collection encompasses on-site visits to confirm which products are indeed in use in a facility. On-site visits are important because procurement databases may not be comprehensive and facilities may purchase products off-contract.

"Top-down" data collection encompasses using product information in a procurement database. Using the procurement database is quicker than the bottom-up method because supplier name, product catalog number, and contact information are readily at-hand. Due to mergers and acquisitions and changes in procurement, products on the shelf may be harder to find in the procurement database, thereby making the contacting of suppliers more challenging.

The combination of on-site visits (bottom-up) with procurement database information (top-down) provided a comprehensive vantage point into the

products in use and supplier contact information. Support of unit-level staff and procurement staff was and will be critical to any efforts in chemical footprinting products in health care.

2.4 Supplier Responses

Sixty-two suppliers were contacted to provide information on chemicals in 358 products. Of the 62 suppliers contacted, 50 suppliers responded to the survey for 253 of the products. Of the 50 suppliers that responded to the survey, nine suppliers reported data for some, but not all of their products. Some of these nine suppliers, rather than provide partial information, only provided data for products for which it could provide complete and accurate information, and for the remaining products provided no data.

Of the 50 suppliers that responded to the survey:

- 18 reported having no CoHCs in their products,
- 31 reported having CoHCs in their products, and
- one answered only a few of the questions (making it impossible to know whether or not its product contained CoHCs or not).

We assessed the quality of the supplier responses with four metrics, and found the quality among and between suppliers to be quite mixed. First, some suppliers answered incorrectly by inverting the response options and answering "yes" where "no" belonged and vice-versa (see Section 2.2 for description of the appropriate survey responses). In these cases, suppliers were contacted and the responses updated. Second, some suppliers answered only a few, as opposed to all, of the 12 questions related to CoHCs. Third, suppliers incorrectly or incompletely answered the question concerning Prop 65 chemicals. For example, some suppliers answered that their product contained BPA, phthalates, or brominated/chlorinated chemicals, but then answered that their product did not contain a Prop 65 chemical despite these chemicals being listed under Prop 65. This is also an indicator that the supplier did not understand the Prop 65 list. Also, if a product contained a Prop 65 chemical, the supplier was requested to provide the CASRN for that chemical. Of the 18 suppliers reporting Prop 65 chemicals in their products, 10 provided CASRNs, one provided CASRNs for some of its products, and seven did not provide any CASRN.

Of the 18 suppliers that reported no CoHCs in their products:

- two answered incorrectly by inverting the response options;
- two did not complete chemical inventories for all of their products, raising the question, how do they definitively know their products do not contain CoHCs if they have not completed an inventory for CoHCs; and
- 14 answered the questions correctly and reported completing chemical inventories for their products – indicating that these surveys were of a higher quality.

Of the 31 suppliers that reported CoHCs in their products:

- four answered incorrectly by inverting answers or answered only a few of the 12 questions related to CoHCs, and did not complete chemical inventories of their products;
- four answered that their product contained BPA, phthalates, or brominated/chlorinated chemicals but then answered that their product did not contain Prop 65 chemicals; and
- of the remaining 23:
  - three did not complete chemical inventories for their products;
  - two did not have complete information on Prop 65 chemicals—these two suppliers seemed to know the limits of their knowledge of chemicals in their products as they could not definitively state that their products did not contain Prop 65 chemicals (an indicator of high quality responses);
  - eight reported Prop 65 chemicals in their products, listed the Prop 65 chemicals, and completed chemical inventories of their products (indicators of high quality responses); and
  - 10 reported no Prop 65 chemicals in their products and reported that they had complete chemical inventories of their products (their responses seemed be of high quality).

Eight suppliers had very high quality responses: they provided detailed information on Prop 65 chemicals by CASRN, their responses on BPA/phthalates aligned with their responses on Prop 65, and in some cases they noted chemicals below the reporting thresholds. For example, the reporting threshold for phthalates is greater than or equal to 1,000 ppm, but at least one company noted that its products contained approximately 200 ppm of DEHP even though it uses a non-phthalate plasticizer in its products. In addition to the eight outstanding respondents, two other companies were generally comprehensive though they either lacked data on all products or provided a generic list of Prop 65 chemicals by CASRN that might be in the product.

The wide variation in supplier responses to the surveys, from no response to detailed responses highlights a few opportunities for improvement:

- Suppliers need to be trained in how to respond to the survey, including understanding the threshold levels associated with CoHCs, which can range from being present at any level for PVC to greater than or equal to 1,000 ppm for phthalates.
- Suppliers need data management systems in place to routinely, consistently, and quickly respond to information requests. Suppliers for which this was the first time they received such a request typically lacked the systems to respond. They indicated that it requires a great deal of time to obtain responses for the hundreds of chemicals included in the survey. Some are just beginning to establish databases for such information.
- Suppliers would benefit from a single list of CASRNs to report on with a uniform reporting threshold (to the fullest extent possible). Ideally, if there was one list that was harmonized across health care organizations it would make the task of collecting and reporting chemical data comparatively easier for suppliers.
- The survey should include a question that asks how companies determine whether CoHCs are in their products. For example, is the supplier responses based on product testing, a chemical inventory, and/or certifications from suppliers?

The above caveats highlight the limits to the data reported by suppliers and detailed in the next section.

3 Results

CHAPTER 3

Results

Clean Production Action in partnership with two health care providers requested data on 358 products from 62 suppliers. Fifty suppliers replied with data on whether chemicals of high concern (CoHCs) are contained in 253 products commonly used in pediatric departments. The data from the two health care providers were combined into one dataset to protect the anonymity of the health care organizations and their suppliers, and because the number and type of products varied widely between the two organizations. The data provided below are illustrative, not definitive, of the chemical footprint of products in a pediatric room.

Products were divided into four categories: medical supplies (185 products), personal care products (50 products), furnishings (11 products), and cleaning products (seven products). Overall, 114 products contained CoHCs (45%) and 139 products did not contain CoHCs (55%) (see Figure 1).

Note that in the descriptions that follow of CoHCs in products, suppliers are required to report CoHCs in the product as well as the packaging. For example, for IV solutions, suppliers reported whether the containers used to package the solutions contained CoHCs, as well as chemicals in the solutions themselves.

IV products, enteral feeding products, respiratory therapy products, and catheters were the medical supplies with the greatest number of products containing CoHCs.

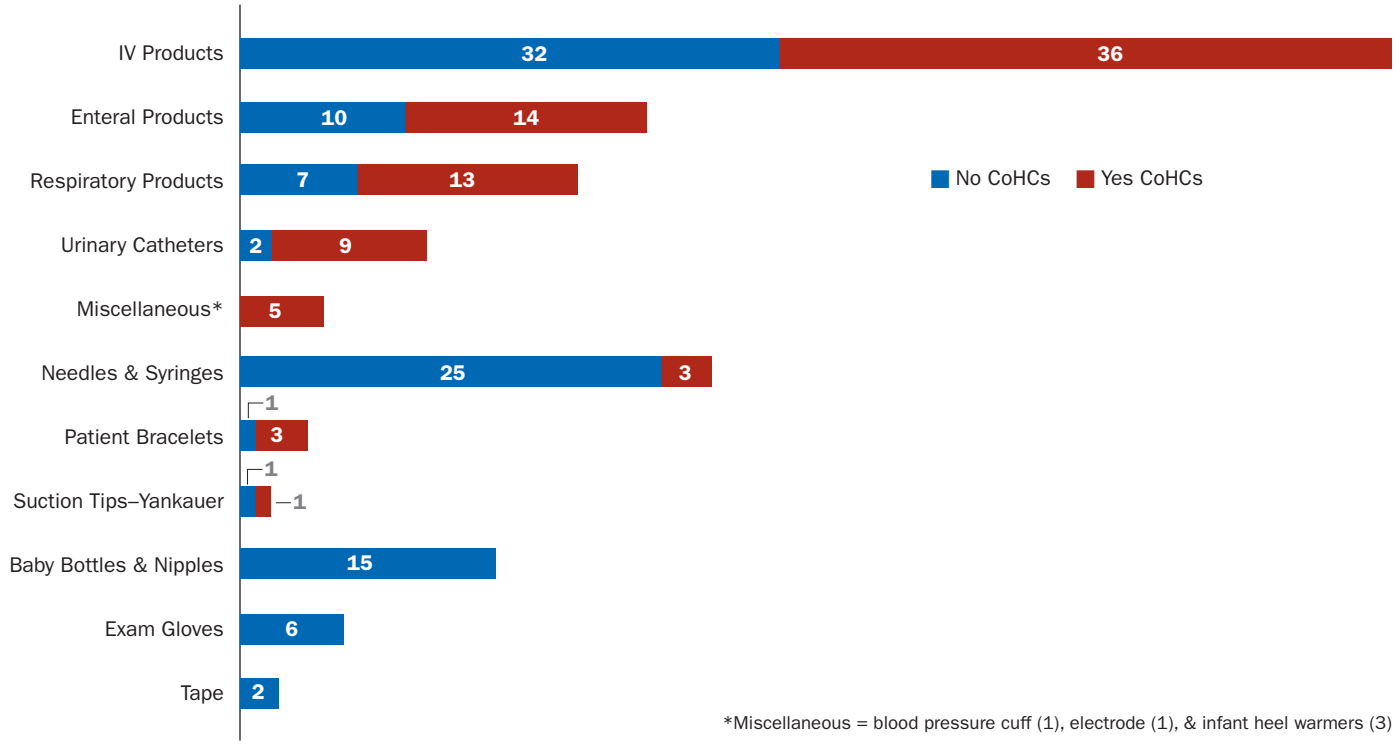
3.1 Medical Supplies

Reflecting their dominance in the patient room, medical supplies included the largest number of products (185) in the survey. Eighty-four (45%) of these products contained one or more CoHC, while the remaining 101 (55%) products contained no CoHCs. The largest categories of products without CoHCs were needles and syringes, in which 90% of the products (25 of 28 products) contained no CoHCs, and baby bottles and nipples, in which none of the 15 products contained CoHCs (see Figure 2). Needles and syringes contained three products with PVC, residual DEHP from a non-phthalate plasticizer, and latex.

IV products, enteral feeding products, respiratory therapy products, and catheters were the medical supplies with the greatest number of products containing CoHCs. Together these four subcategories accounted for 69 of the medical

FIGURE 1. **Number of Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**

FIGURE 2. **Number of Medical Supplies Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



*Miscellaneous = blood pressure cuff (1), electrode (1), & infant heel warmers (3)

supply products with CoHCs. Other products with CoHCs included: needles and syringes, patient bracelets (identification, allergy alert, and fall risk), blood tubing, suction tips, blood pressure cuffs, ECG electrodes, and infant heel warmers.

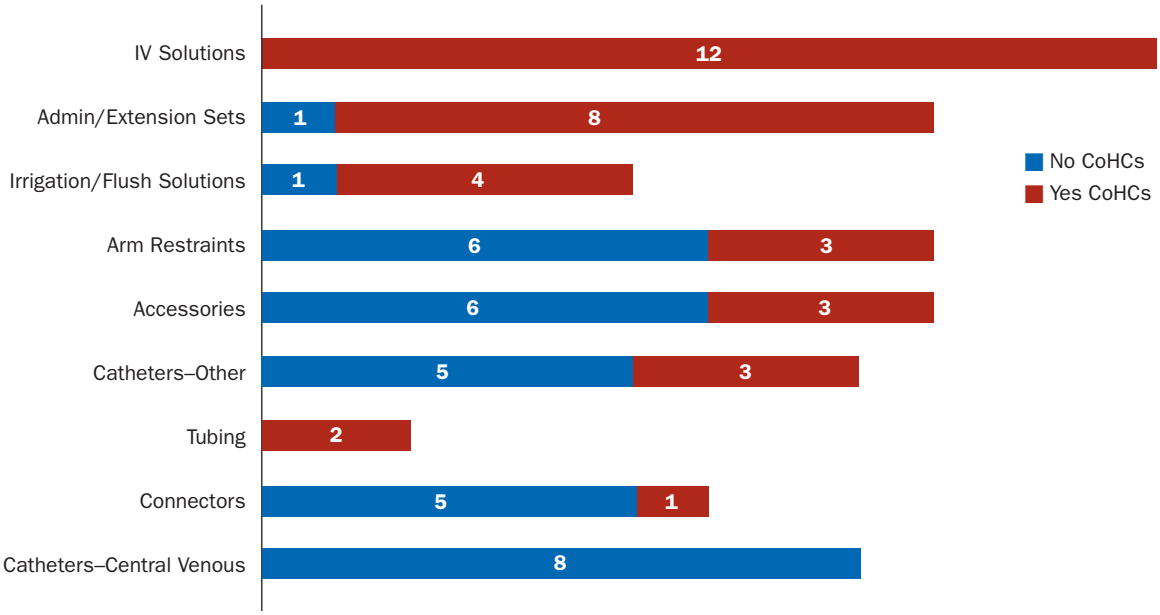
IV products were the largest medical supplies subcategory, with 68 products, including: IV solutions, administration/extension sets, arm restraints, connectors, and catheters. Thirty six of the IV products contained CoHCs (see Figure 3).

All 12 of the IV solution containers contained CoHCs, including PVC, the phthalate DBP, and Prop 65 monomers and solvents. Eight of the nine IV administration/extension sets contained PVC; and among those eight products with PVC, three contained BPA and a mix of Prop 65 monomers and solvents, two contained DEHP, one contained an unspecified phthalate and latex, one contained BPA and latex, and one contained only PVC. Four of the five irrigation/flush solutions and their containers contained the phthalates DBP and DEHP, but surprisingly did not include PVC. The three arm restraints with CoHCs contained PVC (three products) as well as DEHP and antibacterials/ antimicrobials in two products. Three of the eight other catheters contained PVC and/or BPA. Accessories included securement devices for catheters, three of which contained CoHCs including perfluorinated compounds (PFCs—two products), BPA (one product), and unspecified Prop 65 chemicals (one product). None of the central venous catheters contained CoHCs.

Enteral products included 24 feeding tubes, feeding sets, and oral/enteral syringes. **Of the 20 enteral feeding tubes and sets, 14 contained CoHCs, including ten products with PVC, six products with phthalates, and one product with BPA** (see Figure 4). Three of the 10 PVC feeding tubes were nasogastric tubes made with DEHP. Three other feeding tube products contained phthalates in an external sheath that is not intended to come into contact with the patient. None of oral/enteral syringes contained CoHCs.

The third largest category of medical supplies with CoHCs was respiratory therapy products, in which 13 of the 20 products contained CoHCs

FIGURE 3. **Number of IV Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



(see Figure 5). **All of the respiratory therapy products with CoHCs contained PVC and the phthalate DEHP.**

Unlike the central venous catheters, which had no CoHCs, nine of the 11 urinary catheters had CoHCs, including PVC (five products), latex (two products), DEHP and unspecified phthalates (five products), and other Prop 65 chemicals (two products).

Among the miscellaneous other products: three of four patient bracelets (ID, allergy alert, and fall risk) contained CoHCs, including antibacterials/antimicrobials (three products) and PVC (one product); one of the two Yankauer suction tips contained PVC; a blood pressure cuff and ECG electrode contained PVC; and all three infant heel warmers contained a Prop 65 monomer.

3.2 CoHCs in Medical Supplies

The medical supplies product category is dominated by single use, disposable products made from plastic, and the CoHCs found in medical supplies are reflective of these materials. Eighty four of the 185 medical supply products contained CoHCs. **The primary CoHCs found in medical supplies were PVC, phthalates (DIDP, DBP, and DEHP),[23] BPA, and other Prop 65**

FIGURE 4. **Number of Enteral Products Commonly Used in Pediatrics Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**

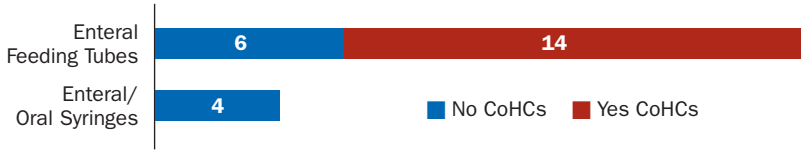


FIGURE 5. **Number of Respiratory Therapy Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**

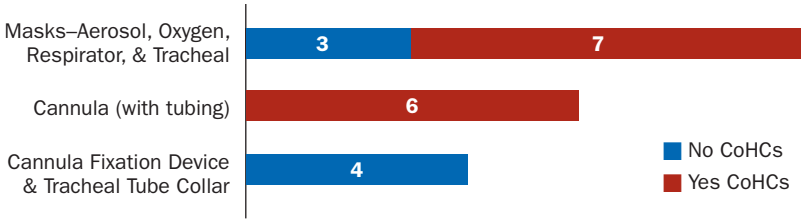
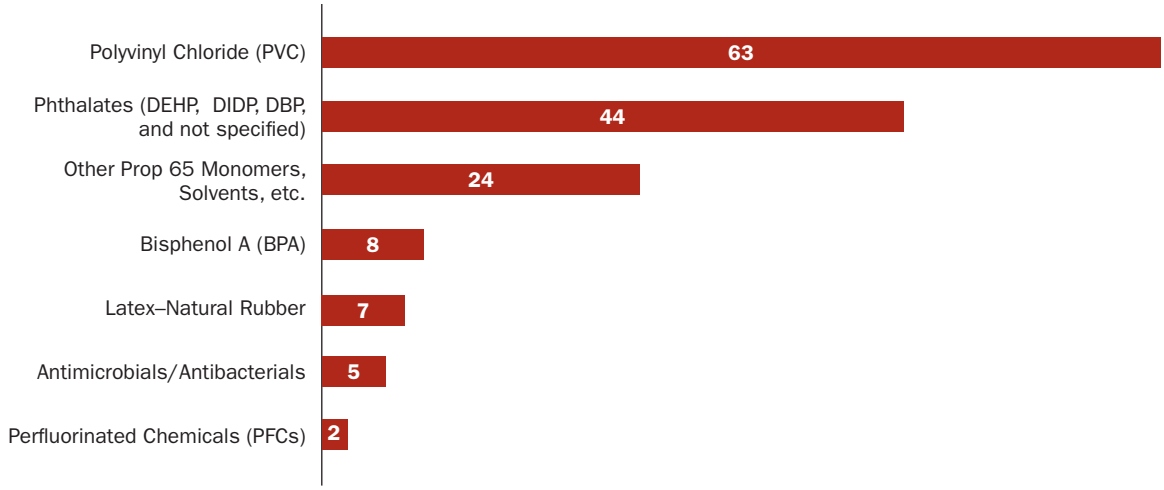


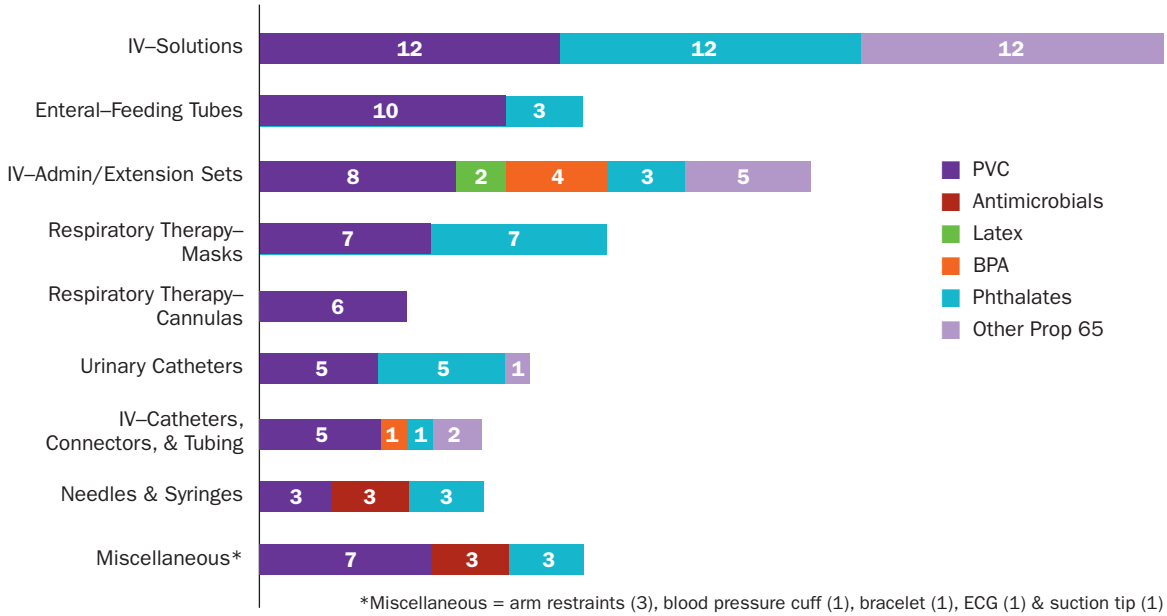
FIGURE 6. **Chemicals of High Concern (CoHCs) in Medical Supplies Commonly Used in Pediatric Patient Rooms and the Number of Products that Contained Them**



chemicals, including monomers and solvents. These four chemicals/chemical classes accounted for 91% of the CoHCs reported in medical supplies (see Figure 6). Chemicals included among the Prop 65 monomers and solvents were benzene, toluene, methylene chloride, acrylonitrile, 1,3-butadiene, styrene, ethylbenzene, and vinyl chloride. The Prop 65 monomers and solvents reported in medical supplies included: benzene (12 products), toluene (12 products), vinyl chloride (12 products), ethyl acrylate (12 products), methylene chloride (5 products), acrylonitrile (4 products), and 1,3-Butadiene (three products).

Of the 63 medical supply products with PVC, 37 contained phthalates, five contained BPA, three contained antibacterials/antimicrobials, and 20 contained other Prop 65 chemicals including monomers and solvents; in addition, five products contained latex. Note that some PVC medical supply products contained multiple CoHCs; for example, both phthalates and Prop 65 monomers and solvents.

FIGURE 7. **Number of Products Containing Polyvinyl Chloride (PVC) and Other Chemicals of High Concern (CoHCs) in Medical Supplies Commonly Used in Pediatric Patient Rooms**



*Miscellaneous = arm restraints (3), blood pressure cuff (1), bracelet (1), ECG (1) & suction tip (1)

Figure 7 highlights the PVC medical supplies and their associated CoHCs for nine categories of medical supplies. Phthalates were most widely found with PVC products because manufacturers add phthalates to PVC to make it flexible; PVC is inherently a rigid plastic. Manufacturers add softening agents, technically known as plasticizers, to PVC to make it flexible. Phthalates are the most widely used plasticizer in PVC.

Medical supplies with the greatest number of PVC- and phthalate-containing products were: a) IV solutions (12 products); b) respiratory therapy masks (seven products); c) urinary catheters (five products); and d) needles and syringes (three products). The IV solutions contained the phthalate DBP, along with a range of Prop 65 monomers and solvents. All of the respiratory therapy products with CoHCs contained PVC and the phthalate DEHP. The urinary catheters contained DEHP (four products) and unspecified phthalates (one product). The needles and syringes contained DEHP at approximately 200 ppm as a mixture or contaminant with a non-phthalate plasticizer.

For the five categories of medical supplies with PVC that were not dominated by phthalates, the products contained a mix of phthalates, BPA, antimicrobials, and/or other Prop 65 chemicals and latex. Respiratory therapy cannulas were the only category of PVC medical supply products that did not contain phthalates (see Figure 7).

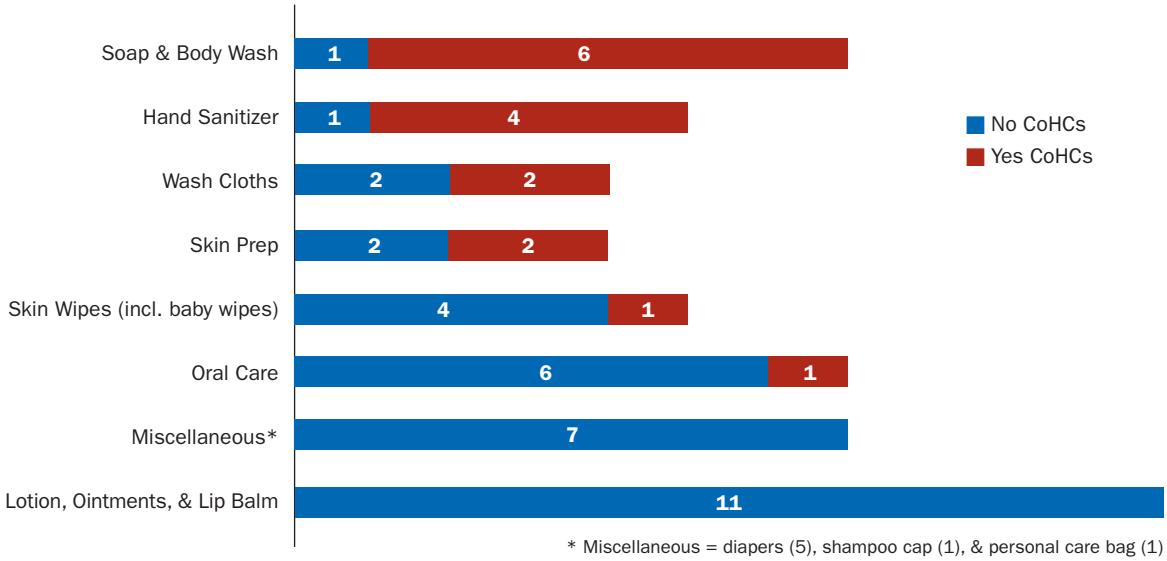
If health care suppliers eliminated PVC and its associated CoHCs from the medical supplies reviewed in this survey, health care organizations would eliminate 75% of the CoHCs in medical supplies.

Interesting to note is that BPA, which is commonly added to PVC in manufacturing, was only reported in five of the 63 medical supply products containing PVC: four IV admin sets and one IV connector. Verification that flexible PVC products do not contain BPA is important given that BPA is a common additive in PVC manufacturing.

Among the 21 medical supply products that contained CoHCs, but not PVC, were:

- irrigation flush solutions (four products with DBP and DEHP, but not PVC);
- infant heel warmers (three products with Prop 65 monomer);
- IV accessories (two products with PFCs and one product with BPA); and
- patient bracelets (two products contained antibacterials/antimicrobials).

FIGURE 8. **Number of Personal Care Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



If health care suppliers eliminated PVC and its associated CoHCs from the medical supplies reviewed in this survey, health care organizations could eliminate 75% CoHCs in medical supplies.

3.3 Personal Care Products

The personal care category included 50 products with 34 (68%) of the products containing no CoHCs and 16 (32%) of the products containing one or more CoHC (see Figure 8). Lotions, ointments, lip balms, diapers, shampoo caps, and personal care bags—along with the majority of skin wipes and oral care products—did not contain CoHCs.

Soap and body wash products contained the most CoHCs in the personal care products category, with six of seven products containing CoHCs: five of the products contained antibacterials/antimicrobials, and three of those products contained latex; and an additional product contained the Prop 65 chemical benzophenone. One soap and body wash product did not contain any CoHCs.

Hand sanitizers followed a similar path as the soap and body wash products, with four of the five products containing CoHCs. All four hand sanitizers with CoHCs contained antibacterials/antimicrobials, and two of those four products contained phthalates. Wash cloths contained a mix of no CoHCs (two products) and CoHCs—two products contained antibacterials/antimicrobials.

Skin preparation products contained latex in two of the four products. Skin wipes included antibacterials/antimicrobials in one product. And oral care included one product with latex.

The dominant CoHCs reported in personal care products were antibacterials and antimicrobials in soaps and washes, hand sanitizers, and skin wipes (12 products) and latex (six products). The latex reported in body washes, soap, and toothpaste requires follow-up with suppliers to know if the latex is in the product or the packaging. Other CoHCs reported with personal care products were phthalates in hand sanitizers and the Prop 65 chemical, benzophenone in soap.

Antibacterials and antimicrobials were the dominant CoHCs across the personal care products.

For every personal care product category that contained a CoHC, there was at least one product that did not contain a CoHC.

Yet for every personal care product category that contained a CoHC, there was at least one product that did not contain a CoHC, thereby highlighting the potential for health care organizations to procure personal care products that contain no CoHCs.

3.4 Disinfectants & Cleaning Products

The seven disinfectant and cleaning products included in the survey consisted of three surface disinfectants, two germicidal wipes, and two general purpose cleaners (see Figure 9).

Reflecting the demands of protecting against bacterial and viral infections in health care, surface disinfectants and germicidal wipes are likely to contain CoHCs. The three surface disinfectants included in this survey all contained antibacterials/antimicrobials, and a cloth used with the disinfectants included the Prop 65 chemical, titanium dioxide. Similarly, both germicidal wipes contained antibacterials/antimicrobials as well as latex. Only the general purpose cleaners did not contain any CoHC, including no antibacterials and antimicrobials.

Infection concerns are driving the use of antibacterials and antimicrobials in many health care products care beyond surface disinfectants. Antibacterials and antimicrobials were reported in over 20% of the products that contained CoHCs, reaching beyond the disinfectants. Beyond surface disinfectants and cleaning products, antibacterials and antimicrobials are being added to a range of products that come into patient skin contact, including IV arm restraints, patient bracelets, cribs, and wash cloths. Figure 10 lists the 26 products identified in this survey of pediatric products that contained antibacterials and antimicrobials. **For every product listed in Figure 10, except cribs, surface disinfectants, and germicidal wipes, alternative products were identified that did not contain CoHCs, including antibacterials and antimicrobials.**

3.5 Furnishings

The furnishings category included cribs, crib mattresses, beds, bed mattresses, and other patient furniture (a stool and an overbed table). In total, 11 products were included in the survey,

Antibacterials and antimicrobials are being added to a range of products that come into patient skin contact, including IV arm restraints, patient bracelets, cribs, and wash cloths.

FIGURE 9. **Number of Disinfectants and Cleaning Products Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**

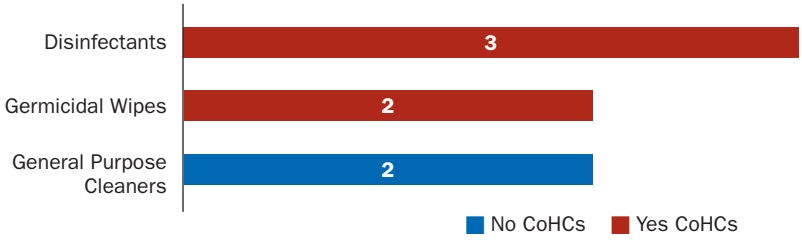


FIGURE 10. **Number of Products Commonly Used in Pediatric Patient Rooms that Contained Antibacterials and Antimicrobials**

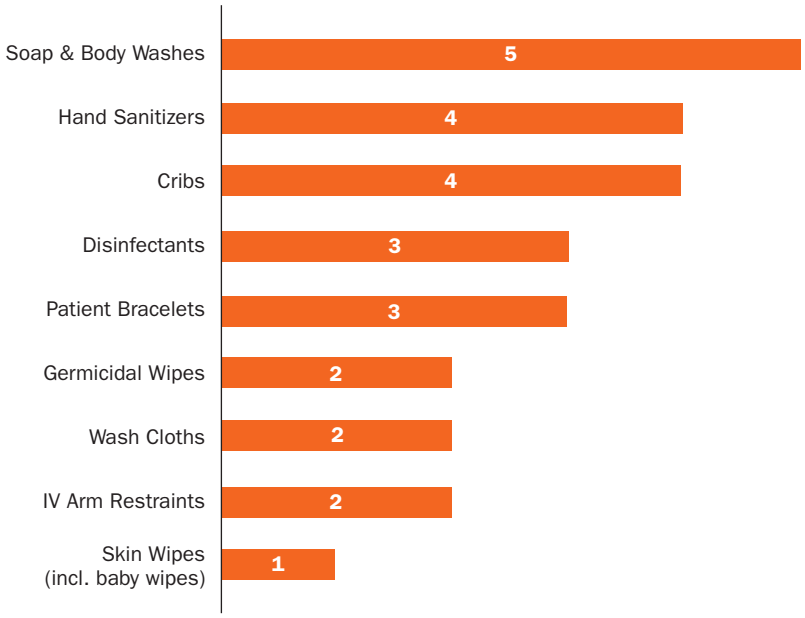
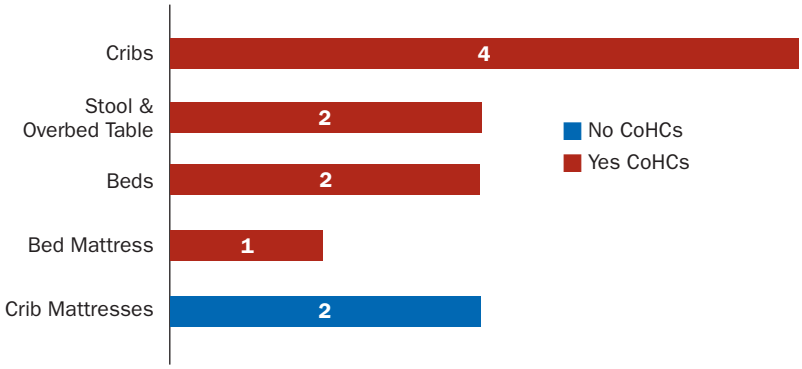


FIGURE 11. **Number of Furnishings Commonly Used in Pediatric Patient Rooms that Contained and Did Not Contain Chemicals of High Concern (CoHCs)**



with all of the products except crib mattresses containing CoHCs (see Figure 11).

All four cribs contained PVC and antibacterials/antimicrobials, while the crib mattresses contained no CoHCs. The other patient room furniture, stool and overbed table, included PVC (overbed table), BPA (stool), halogenated flame retardants (overbed table), heavy metals (stool and overbed table), and other Prop 65 chemicals (overbed table).

Patient beds were the most complex product included in the entire survey, and the only product that contained electrical equipment. Not surprisingly, given their complexity, patient beds included the greatest number of CoHCs, including: PVC, halogenated and non-halogenated flame retardants, heavy metals, PBTs, EU RoHS chemicals, BPA, phthalates, and Prop 65 solvents. Bed mattresses also contained a wide range of CoHCs, including PVC, halogenated and non-halogenated flame retardants, heavy metals, PFCs, BPA, phthalates, and other unspecified Prop 65 chemicals.

Electric beds, due to the complexity of materials and electronic and electrical components, are likely to contain CoHCs. The question then is not, "Does the bed contain CoHCs?" The questions should be, "What is the chemical footprint of this bed? How many CoHCs does a bed contain and what is the mass of CoHCs in this bed?" Suppliers of complex products such as beds should report the chemical footprint—the count and mass of CoHCs—of their products. Then suppliers can quantitatively report reductions and health care organizations can benchmark products and track reductions in CoHCs in complex products such as patient beds.

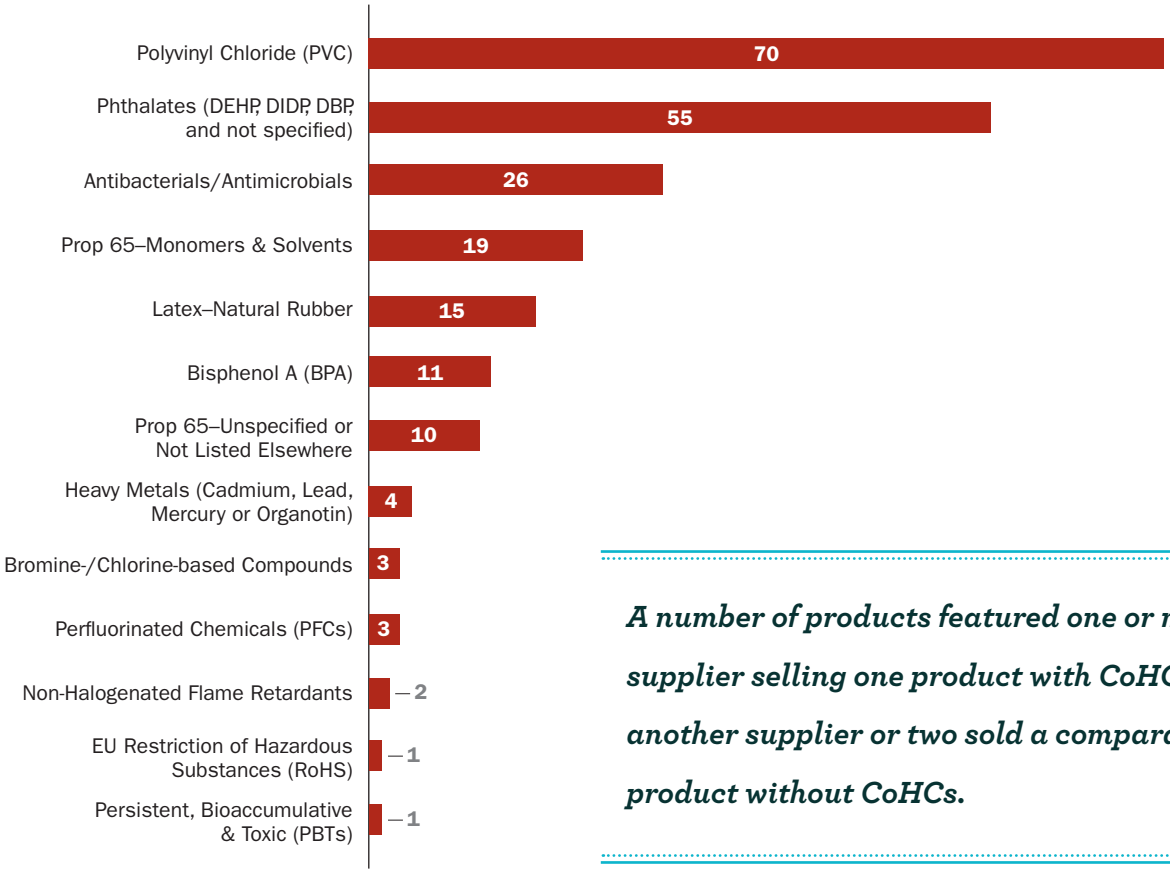
3.6 CoHCs in Pediatric Products

The dominant CoHCs in pediatric products are PVC, phthalates, antibacterials/antimicrobials, Prop 65 monomers and solvents, latex, and BPA. Together these six chemicals/chemical classes accounted for 89% of the reported instances of CoHCs in pediatric products (see Figure 12).

Since Prop 65 chemicals overlap with nearly every group except PVC and latex, they are not listed in their entirety in Figure 12. Rather, Figure 12 lists phthalates, BPA, heavy metals, EU RoHS directive chemicals, PBTs, PFCs, and bromine-/chlorine-containing compounds separately from Prop 65. The remaining Prop 65 chemicals are disaggregated in Figure 12 into two groups: a) monomers and solvents; and b) "unspecified" or "not listed elsewhere." Respondents to the survey were asked to list Prop 65 chemicals by CASRN, but in some cases they did not do so. When this occurred, we referred to this as an "unspecified" Prop 65 chemical. "Not listed elsewhere" chemicals are Prop 65 chemicals that did not fall within any other category listed in Figure 12. We categorized those chemicals, such as benzophenone, as Prop 65 "not listed elsewhere."

Suppliers and health care organizations would substantially reduce CoHCs in products by avoiding where possible products that do not

FIGURE 12. **Chemicals of High Concern (CoHCs) and the Number of Products in Pediatric Patient Rooms that Contained Them**



A number of products featured one or more supplier selling one product with CoHCs while another supplier or two sold a comparable product without CoHCs.

contain PVC, phthalates, and antibacterials/antimicrobials. Since PVC and phthalates are typically linked together, and the Prop 65 monomers and solvents are heavily associated with the PVC products, avoiding PVC-based products would significantly reduce CoHCs in pediatric products, especially medical supplies.

A number of products featured one or more supplier selling one product with CoHCs while another supplier or two sold a comparable product without CoHCs:

- enteral feeding tubes: some contained PVC while others contained no CoHCs;
- IV arm restraints: some contained PVC while others contained no CoHCs;
- IV catheters: come contained BPA or PVC while others contained no CoHCs;
- skin prep: some contained latex while others contained no CoHCs;
- all of the following products featured some suppliers selling the product with anti-bacterials / antimicrobials and others selling the equivalent product without these chemicals:
  - soaps and body washes,
  - hand sanitizers,
  - patient bracelets,
  - wash cloths, and
  - skin wipes.

These products represent potentially quick opportunities for substitution. For other products containing CoHCs, alternatives may be available but will require further research.

Overall this generalized chemical footprint of a pediatric patient room indicated that approximately 45% of the products are likely to contain CoHCs. The specific percentages will vary depending on the health care system and its purchasing practices.

4 Recommendations: Where do we go from here?

CHAPTER 4

Recommendations

This first chemical footprint of products used in a pediatric patient room revealed a number of opportunities for action. Specifically, this research demonstrates how health care organizations can measure and reduce their chemical footprints, highlights the need to perform additional research to fill data gaps, and identify products that do not contain chemicals of high concern (CoHCs), and clarifies the value of investing in systemic initiatives that will enable the rapid measurement and reduction of chemical footprints.

This research demonstrates how health care organizations can measure and reduce their chemical footprints, highlights the need to perform additional research to fill data gaps, and identify products that do not contain chemicals of high concern (CoHCs).

Measure Chemical Footprint

Many health care organizations have taken important steps to reducing CoHCs, such as BPA, phthalates, brominated flame retardants, and PVC in the products they purchase and use every day. This chemical footprinting research demonstrates that hospitals can measure their chemical footprint, thereby creating a baseline to which they can measure their progress. Without

a baseline metric it is impossible to measure progress away from CoHCs to safer alternatives.

This research provides a starting point for understanding the chemical footprint of products commonly used in a pediatric patient room and identifies five key steps for measuring the chemical footprint of products in the health care setting: 1) identify products to evaluate for CoHCs; 2) identify annual usage of those products purchased; 3) identify list of CoHCs; 4) ask suppliers which products contain CoHCs; and 5) compile list of pediatric products that contain and do not contain CoHCs. With these data in hand health care organizations can measure their progress in reducing their chemical footprint.

The next research step for these products is to gather data on the specific end uses of those products and determine whether they can be substituted without offsetting required levels of performance.

Identify Safer Alternatives

Two key additional research needs emerged over the course of this study. First is the need to identify alternative products that do not contain CoHCs. For the 114 products that contain CoHCs, the question is, "are there alternatives on the market that do not contain CoHCs?" Specific product categories in need of research on alternative products are:

- IV products (including administration/ extension sets, connectors, and tubing),
- enteral and total parenteral nutrition (TPN) products,
- catheters,
- blood tubing,
- respiratory therapy products,
- personal care products (skin wipes, hand sanitizers, soaps/body washes), and
- cleaning products (general purpose/facility cleaners and surface cleaners).

A second research need is within product categories where some products contained CoHCs and other similar products did not contain CoHCs. The research question here is: "are the products meeting the same specifications and functional use?" The next research step for these products is to gather data on the specific end uses of those products and determine whether they can be substituted without offsetting required levels of performance.

Reduce Chemical Footprint

With alternative products identified that do not contain CoHCs, health care organizations will have the information they need to replace products. With data on number of products with CoHCs and information on the availability of safer alternatives, health organizations will be able to engage suppliers in evaluating, selecting, and purchasing alternative products that do not contain CoHCs while meeting performance and price requirements. A step along this path would be to set goals for reducing the chemical footprint by percent or number of products per year.

Systemic Changes

Measuring and reducing chemical footprints requires the collection, management, and analysis of data that is not the expertise of most health care organizations. The following actions would simplify the process for all health care organizations interested in tracking and reducing CoHCs in products:

- **CoHCs**: Agree to a common list of CoHCs for health care. A common list of CoHCs will simplify reporting requirements for suppliers and facilitate reductions in these chemicals in the health care sector. Starting points for a common list of CoHCs include the Chemical Footprint Project's list of CoHCs (which is based on GreenScreen List Translator™),[25] Practice Greenhealth's Standardized Environmental Questions for Medical Products,[15] and Kaiser Permanente's Sustainability Scorecard.[16]
- **Reporting**: Require suppliers to (or prefer suppliers that) report chemical ingredients to a common template. An example from the building sector is the Health Product Declaration Collaboration's HPD Open Standard,[26] which many building product manufacturers use to report all chemicals in their products

to interested purchasers. A model template for reporting chemical ingredient information would provide suppliers and health care organizations with a common platform for filing and sharing chemical ingredient information.

- **Certification**: A third-party certification of products that meet the criteria for absence of CoHCs in products would greatly simplify communication between suppliers and health care organizations. Suppliers could use the recognition of a certification to highlight that they know the chemicals in their products and that their products do not contain CoHCs, while health care organizations could simply ask for certified products—thereby eliminating the need to specify and track CoHCs in the products from suppliers. The GreenScreen Certified™ Standard for Textile Chemicals[27] is an example of a certification program that could be readily applied to health care products.

A model template for reporting chemical ingredient infor-mation would provide suppliers and health care organizations with a common platform for filing and sharing chemical ingredient information.

The chemical footprinting of products commonly used in pediatric patient rooms reveals a clear set of next steps that will enable health care organizations to reduce CoHCs in products they use every day beyond what is required by regulations. Additionally the research highlights the importance of suppliers knowing the chemicals in their products and putting into place policies and procedures to identify and reduce CoHCs. Together suppliers and health care organizations can advance the use of green chemistries that are safe and healthy for people and the planet.

Endnotes

1. For example, see: "Examples of Corporate Chemicals Policies," *Clean Production Action*, accessed October 31, 2017, *https://www.bizngo.org/safer-chemicals/examples-corporate-chemicals-policies*.
2. Lindsey Konkel, "Chemical Footprinting," *Environmental Health Perspectives* 123 no. 5 (2015): A130-3, *https://ehp.niehs.nih.gov/wp-content/uploads/123/5/ehp.123-A130.alt.pdf.*

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3. Mark Rossi, Cheri Peele, Sally Edwards and Tim Greiner, "Chemical footprinting strides to become mainstream with Walmart," *GreenBiz*, August 11, 2017, *https://www.greenbiz.com/article/chemical-footprinting-strides-become-mainstream-walmart.*
4. Dibutyl phthalate (DBP) (CASRN 84-74-2); diisodecyl phthalate (DIDP) (CASRN 68515-49-1 or 26761-40-0); and di-2-ethyl hexyl phthalate (DEHP) (CASRN 117-81-7).
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6. *NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Di(2-Ethylhexyl) Phthalate (DEHP)* (North Carolina: Center for the Evaluation of Risks To Human Reproduction, 2006), *https://ntp.niehs.nih.gov/ntp/ohat/phthalates/dehp/dehp-monograph.pdf.*
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8. *Market surveillance of PVC medical devices presented DEHP-free* (France : Agence Nationale de Sécurité du Médicament, November 2015), *http://ansm.sante.fr/var/ansm_site/storage/original/application/22440dbf7102e0c808d1f298a62fdc2f.pdf.*
9. See note 1 above.
10. Lindsey Konkel, "Chemical Footprinting," *Environmental Health Perspectives* 123 no. 5 (2015): A130-3, *https://ehp.niehs.nih.gov/wp-content/uploads/123/5/ehp.123-A130.alt.pdf*.
11. See note 2 above.
12. See note 3 above.
13. Phillip J. Landrigan and Lynn R. Goldman, "Children's vulnerability to toxic chemicals: a challenge and opportunity to strengthen health and environmental policy" *Health Affairs* 30 no. 5 (2011): 842-50, *http://content.healthaffairs.org/content/30/5/842.full*.
14. Koppe JG1, Bartonova A, Bolte G, Bistrup ML, Busby C, Butter M, Dorfman P, Fucic A, Gee D, van den Hazel P, Howard V, Kohlhuber M, Leijs M, Lundqvist C, Moshammer H, Naginiene R, Nicolopoulou-Stamati P, Ronchetti R, Salines G, Schoeters G, ten Tusscher G, Wallis MK, Zuurbier M., "Exposure to multiple environmental agents and their effect," *Acta Paediatr Suppl. 53* (2006): 106-13, *https://www.ncbi.nlm.nih.gov/pubmed/17000577.*
15. "Standardized Environmental Questions for Medical Products," *Practice Greenhealth*, accessed October 31, 2017, *https://practicegreenhealth.org/initiatives/greening-supply-chain/standardized-environmental-questions-medical-products.*
16. "Kaiser Permanente Launches Sustainability Scorecard for Medical Products," *Kaiser Permanente*, May 4 2010, *https://share.kaiserpermanente.org/article/kaiser-permanente-launches-sustainability-scorecard-for-medical-products.*
17. Chemicals include cadmium, mercury, lead, hexavalent chromium, and polybrominated biphenyls, polybrominated diphenyl ethers.
18. Structural/functional analogues include: bisphenol AP, bisphenol AF, bisphenol B (BPB), bisphenol C, bisphenol C2, bisphenol E (BPE), bisphenol F (BPF), bisphenol G, bisphenol M, bisphenol S (BPS), bisphenol P, bisphenol PH, bisphenol TMC, bisphenol Z, and 4-cumylphenol (HPP) or Bisphenol A derived chemicals.

19. Including but not limited to: tetrabromobisphenol-A (CASRN 79-94-7); hexabromocyclododecane (CASRN 25637-99-4); decaBDE (decabromodiphenyl ether) (CASRN 1163-19-5); octaBDE (octabromodiphenyl ether) (CASRN 32536-52-0); pentaBDE (pentabromodiphenyl ether) (CASRN 32534-81-9); tris (2-chloroisopropyl phosphate) (TCPP) (CASRN 13674-84-5); tris(2-chloroethyl) phosphate (TCEP) (CASRN 115-96-8); and Dechlorane Plus™ (CASRN 13560-88-9).

20. Phthalates include di-2-ethyl hexyl phthalate (DEHP) (CASRN 117-81-7); benzyl butyl phthalate (BBP) (CASRN 85-68-7); di-n-hexyl phthalate (DnHP) (CASRN 84-75-3); diisodecyl phthalate (DIDP) (CASRN 68515-49-1 or 26761-40-0); dibutyl phthalate (DBP) (CASRN 84-74-2); diisononyl phthalate (DINP) (CASRN 28553-12-0 and 68515-48-0); Diisobutyl phthalate (DIBP) (CASRN 84-69-5); di n-pentyl phthalate (DPENP) (CASRN 131-18-0); dicyclohexyl (DCHP) (CASRN 84-61-7); and di-n-hexyl phthalate (DHEXP) (CASRN 84-75-3).

21. Defined by the U.S. Environmental Protection Agency (EPA) (see *https://www.dtsc.ca.gov/SCP/upload/1-L-US-EPA_NWM.pdf and https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-covered-tri*); OSPAR Chemicals for Priority Action list (*http://www.ospar.org/work-areas/hasec/chemicals/priority-action*); and the United Nations Environment Programme Stockholm Convention on Persistent Organic Pollutants (*http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx*).

22. Lead and lead-containing compounds in concentrations exceeding 40 ppm, mercury and mercury-containing compounds exceeding 100 ppm, cadmium and cadmium-containing compounds exceeding 100 ppm, Organotin compounds (e.g. tributyltin (TBT), dibutyltin (DBT)) exceeding 100 ppm.

23. Dibutyl phthalate (DBP) (CASRN 84-74-2); diisodecyl phthalate (DIDP) (CASRN 68515-49-1 or 26761-40-0); and di-2-ethyl hexyl phthalate (DEHP) (CASRN 117-81-7).

24. *The safety of medical devices containing DEHP plasticized PVC or other plasticizers on neonates and other groups possibly at risk* (Luxembourg: Scientific Committee on Emerging and Newly-Identified Health Risks, 2016), *https://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_047.pdf.*

25. Cheri Peele, Sally Edwards, Tim Greiner, Mark Rossi, *The Chemical Footprint Project Survey 2016 Guidance Document* (Somerville, MA: Clean Production Action, 2016), *https://www.chemicalfootprint.org/assess/cfp-tool-guidance-document-request*.

26. *Project Team User Guide: Using Health Product Declaration® Open Standard, version 2.1* (Wakefield, MA: Health Product Declaration Collaborative, 2017), *https://www.hpd-collaborative.org/hpd-user-guide.*

27. "GreenScreen Certified™," *Clean Production Action*, accessed October 31, 2017, *https://www.greenscreenchemicals.org/certified*.

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