

The Mattress *Still* Matters

Protecting Babies and Toddlers
from Toxic Chemicals While They Sleep



CLEAN &
HEALTHY
NEW YORK



GETTING READY FOR BABY

Acknowledgements

WRITTEN BY

Clean and Healthy New York

518.641.1552

info@cleanhealthyny.org

www.cleanhealthyny.org

Ecology Center of Michigan

734.761.3186

info@ecocenter.org

www.ecocenter.org

ANALYTICAL PARTNERS

Dr. Marta Venier, Indiana University

Dr. Graham Peaslee, University of Notre Dam

REVIEWED BY

Jackie Bowen, Clean Label Project

Kathleen Curtis, Clean and Healthy New York

Anne Hulick, Clean Water Action CT

Avinash Kar, Natural Resources Defense Council

Philip J. Landrigan, MD, MSc, Boston College

Kim Richman, Esq. Richman Law Group

WITH GRATITUDE

This report was made possible through the generous support of the New York Community Trust, the Park Foundation, and the Marisla Foundation.

PHOTO CREDITS

Photos/images on cover, pages 7, 11, 16, 24, 27, 30, 31, 36, Canva. Page 3, Boston College. Page 8, Shutterstock.

Contents

3	Foreword
4	Executive Summary
6	Introduction
7	What's in a Crib Mattress?
9	Chemicals of Concern in Crib Mattresses
13	What's in a Mattress: Company Disclosures
17	Chart of Materials disclosed by Companies
19	What's in a Mattress: Test Results
21	What's in a Mattress: Reconciling Testing and Disclosure
23	Finding the Safest Mattress on Any Budget
25	Certifications
28	Additional Considerations
29	Recommendations
31	Lessons for the Broader Market
32	References
35	Appendix I: Detailed Methods
37	Appendix II: Template letter to retailers

Disclaimer

The content of this report is intended to provide information about materials used in crib mattresses reported by companies via their websites, via email and written communication, or identified through laboratory testing. We do not recommend or reject any specific mattress manufacturer or product. Our survey covers a representative majority of crib mattress manufacturers and their products advertised for sale in the U.S. market on company websites (with limited additions) in late 2019 and early 2020. However, we make no claim that our survey was exhaustive or that all models are still available. Any oversights were entirely unintentional and do not represent discrimination by the authors. Further, we make no claim that a specific chemical or material of concern as identified in this report will cause a specific health outcome for a specific child, or that its absence would prevent any specific health effects. The information herein is intended solely as an educational tool, to provide parents with useful information to consider in their decision-making process. We also intend manufacturers, brands, retailers, child care providers, and government bodies to use this as guidance for best practices in crib mattress construction and ingredient transparency.

Publication date: July 26, 2020

Foreword

Parents often ask me, “Doctor, isn’t it true that if a product is on the shelf in my favorite store it must be safe?” Sadly, the answer I must give to this question is, “No. The fact that a product is beautifully packaged and on the shelf in a store is no guarantee at all that it is safe.”

What too many parents do not realize is that in the United States we have some of the weakest chemical policies of any country in the Western world. Federal agencies in our country are not keeping dangerous chemicals out of products intended for use by children. The result is that all of our children are at risk of exposure every day to materials like vinyl chloride, volatile organic compounds, organohalogen and organophosphate flame retardants, and per- and polyfluorinated chemicals (PFAS) – highly dangerous chemicals whose names are difficult to pronounce and that should never have been allowed on the market.

Because the federal agencies are not doing their job, parents need to take action to protect their children’s health. And to take effective action, parents need accurate, honest, unbiased information.

That is why this report, *The Mattress Still Matters*, is so important. This report provides critical information for parents that is available nowhere else. It is based on painstaking research by Clean and Healthy New York and the Ecology Center of Michigan, independent non-profit organizations whose only goal is to safeguard children’s health.

I encourage every parent and parent-to-be who is in the market for a crib mattress to take a few minutes to read this report. It’s beautifully written and the recommendations are crystal clear. And if you’re really stressed for time, you should at least read the 2-page Executive Summary. It’s the Cliff Notes version of the report and contains all of the essential information.

The information in this report will help you to protect your baby’s health.

Sincerely,



Philip J. Landrigan, MD, MSc, FAAP



Dr. Landrigan is a pediatrician and specialist in preventive medicine who has worked at the Centers for Disease Control and Prevention (the CDC) and at the Mount Sinai Medical Center in New York City. He is now Director of the Program for Global Public Health and the Common Good at Boston College. Dr. Landrigan is a member of the Board of Clean and Healthy New York.

Executive Summary

There's nothing that new parents care about more than keeping their babies healthy. Much care goes into picking diapers, car seats, clothes—and cribs mattresses.

No parent wants those carefully chosen items to include chemicals that could increase the likelihood that their child might face lifelong health challenges like cancer, diabetes, heart disease, learning and developmental disabilities, and asthma.¹

Parents should be confident that items made for babies are free of such harmful chemicals, but that is too often not the case.

How are product makers doing at prioritizing our health and the environment? To find out, we have zoomed in to focus on crib mattresses, because babies sleep up to 18 hours each day, and their crib is the place they spend most of their time.

The Mattress Still Matters, a follow-up to a 2011 report, *The Mattress Matters*, investigates what companies disclose about the materials they choose and how that compares to laboratory analysis of mattresses. We assess what we can learn about mattresses in specific, and the broader marketplace in general.

We reviewed 227 product webpages from 37 crib mattress brands to determine what we could learn about the materials they use. We sent that information to companies for their review and feedback. 13 mattresses from 13 different brands were analyzed with laboratory tests to compare company disclosures with the chemicals detected. Mattresses were purchased in late 2018 and early 2019. Models can change frequently; this report is a snapshot in time.

FIRST, THE GOOD NEWS

Two mattresses by Sealy™ without disclosed chemicals of concern are available for less

than \$100:

- EverLite™ 2-Stage crib mattress \$99
- Premier Posture™ 2-Stage crib mattress \$99.

Ten mattresses from six brands don't rely on petroleum and avoid all chemicals of concern.

They are made by Lifekind®, Naturepedic®, Obasan, OMI®, Soaring Heart, and White Lotus Home.

Additionally, company information indicates that **19 products from five companies are free of vinyl, polyurethane foam, added flame retardants, PFAS, antimicrobials, or added minerals:** Lullaby Earth™, My Green Mattress, Naturepedic®, Oeuf, and Sealy™.

KEY CHEMICALS OF CONCERN

PFAS waterproofing chemicals can contribute to immune and thyroid problems, and cancer.²

Antimicrobials may appear to help keep babies healthy, but there is no evidence that they reduce disease. They are not needed.³

Flame retardants⁴ are used in barriers or added to foam to meet federal flammability standards, made with bromine or chlorine (called organohalogens), phosphorus or nitrogen in harmful forms, or the heavy metal **antimony trioxide**.⁵

Polyvinyl chloride⁶ (PVC or vinyl) is a cheap waterproof cover material or coating that requires many additives, including bisphenol A and **plasticizers**. Plasticizers used in crib mattresses no longer include ortho-phthalates, but replacements are not well studied.⁷

Polyurethane, especially when used as foam, contains blowing agents, fillers, additives and inputs that are not disclosed⁸ and may be harmful.^{8,9}

Learn more starting on page 9.

HOW TRANSPARENT ARE COMPANIES?

- 35% of those surveyed—10 companies—provided information about each major component of their mattresses.
- 13% provided information about most of those major components.
- **A majority of companies—52% - did not disclose most or all of their materials. 22% of companies had significant gaps on their websites.**
- **Only 4 of the 13 items we tested matched test results and information provided by companies.**

Learn more starting on page 13.

CHEMICALS OF CONCERN FINDINGS

- Brands reported **vinyl** in 27% of their crib mattress covers. Of the 13 tested, six were made of vinyl, and all six contained **plasticizers**.
- **PFAS** chemicals were disclosed for nine products from three companies, and testing found additional PFAS in mattresses made by Safety 1st®, Colgate Mattress, and a mattress previously produced by Nook Sleep.
- One company, Newton Baby® reported adding a phosphorus-based **flame retardant (FRs)** chemical to their core and we confirmed that through testing. Another, Bloom Baby reported an ammonium polyphosphate FR layer.
- Our testing identified seven mattresses that contained indications of FRs: four had combinations of bromine, chlorine and phosphorus. Five contained antimony at relatively high levels.
- Two-thirds of brands now report using flame barriers, and **12% of mattresses are designed without barriers or additives**. Two FR barriers and two vinyl covers we tested contained antimony. One company uses modacrylic barriers.
- Seven companies make claims about **antimicrobial** properties. One uses silver, one quaternium compounds, one a zinc-based solution, and four don't say what imparts that property.

Learn more starting on page 14.

CERTIFICATIONS

We identified **three strong independent “third party” certifications**, which address a broad range of chemicals of concern with stringent standards:

- MADE SAFE®
- Global Organic Latex Standard (GOLS)
- Global Organic Textile Standard (GOTS)

Crib mattress brands use four additional independent certifications with narrower scopes: OEKO-TEX®, UL GREENGUARD®, UL GREENGUARD® Gold, UL Formaldehyde Free.

Be wary of “second party” trade association certifications: for example, the Polyurethane Foam Association-created CertiPUR-US® is based on meeting legal requirements; JPMA’s in-house standard does not address harmful chemicals.

Learn more about certifications on page 24.

RECOMMENDATIONS

Parents should check for specific information about materials from brands, choose strong certifications, avoid chemicals of concern, and urge brands and retailers to take action.

Child care providers should talk with brands and vendors they use to purchase mattresses to avoid chemicals of concern and urge companies to screen out harmful chemicals for all products.

Manufacturers and brands should redesign products to avoid the chemicals of concern in products at all prices, have this verified by strong independent certifications, and make product descriptions thoroughly disclose all chemicals and components.

Retailers should set chemical policies that include the chemicals of concern in this report, verify compliance through testing, and display full product information. All mattresses offered, regardless of price, should be made of safer materials.

Elected officials should ban chemicals of concern, especially PFAS and flame retardants.

See more detailed recommendations on page 28.

Introduction

Babies are uniquely vulnerable to chemicals in their environment. They are still undergoing a rapid period of development until they turn three, and they are profoundly affected by their environment – including people interacting with them, rest, exploring the world around them, and chemicals they breathe in, swallow, or absorb through their skin.

A newborn baby sleeps on average 16 to 17 hours a day¹⁰ and by age three, toddlers still need 12 to 14 hours each day. That means that a crib mattress, which can be used in toddler beds as well, is a key component of their primary environment for their entire early childhood.

Therefore, what a crib mattress is made of matters a lot. Some mattresses are made with organic and natural materials, others contain materials that are known to contribute to health problems in humans and animals. The trouble is, it's not always easy to tell which is which.

That's where this report comes in. We assessed what materials are present in crib mattresses from two directions: first, we reviewed the marketplace, researched public statements about mattress materials as made by brands on their websites, and wrote to the companies to confirm, update, or expand the information they made public. Then, we selected a subset of those mattresses and tested them for key chemicals of concern.

Scientific research over the last century has revealed and deepened our understanding about health and environmental harms caused by thousands of widely used chemicals, and yet **our information is incomplete, with many tens of thousands of chemicals largely unstudied for their full range of impacts.**

What kinds of impacts? **Harmful chemicals have been identified that contribute to or cause many of**

the chronic diseases now plaguing people, including childhood and adult cancer, heart disease, asthma, damage to other organs, learning and developmental disabilities, reproductive harm, obesity, and diabetes.¹¹ Some chemicals are more harmful when mixed with others. Environmental impacts from the production and disposal of these substances include emissions from oil extraction and refining, land and water pollution from metal mining, releases of harmful chemicals into the air and water, leaching from landfills, and releases from incineration.

Chemicals of concern in crib mattresses include vinyl (also known as PVC or polyvinyl chloride), plasticizers (added to vinyl to make it flexible), antimony, modacrylic, volatile organic compounds (VOCs), and per- and polyfluoroalkyl substances (PFAS include PFOS, PFOA and thousands of others). **Learn more on page 9.**

Despite significant movement toward less and non-toxic fire-safe materials, some companies continue to make mattresses with toxic flame retardants in either foam or barrier materials. There is also concern about materials made from petroleum, including vinyl, polyester, polyethylene, and polyurethane, as well as pesticides and processing chemicals on natural materials like cotton, wool, and latex.

The crib mattress sector is relatively small — only a few dozen brands, a couple hundred models — and yet, it reflects the trends and pressures of the broader material economy: some brands or models are made to be as inexpensive as possible, using the cheapest materials available. Some are made of the highest quality, least-toxic materials.

What's in a Crib Mattress?

Determining just what is in a crib mattress can be challenging. There are multiple sources of information consumers will be confronted with: the marketing materials on the box or packaging if you're shopping in a store, the tags on the product once you purchase and open the packaging, product descriptions on brand websites, and product descriptions included

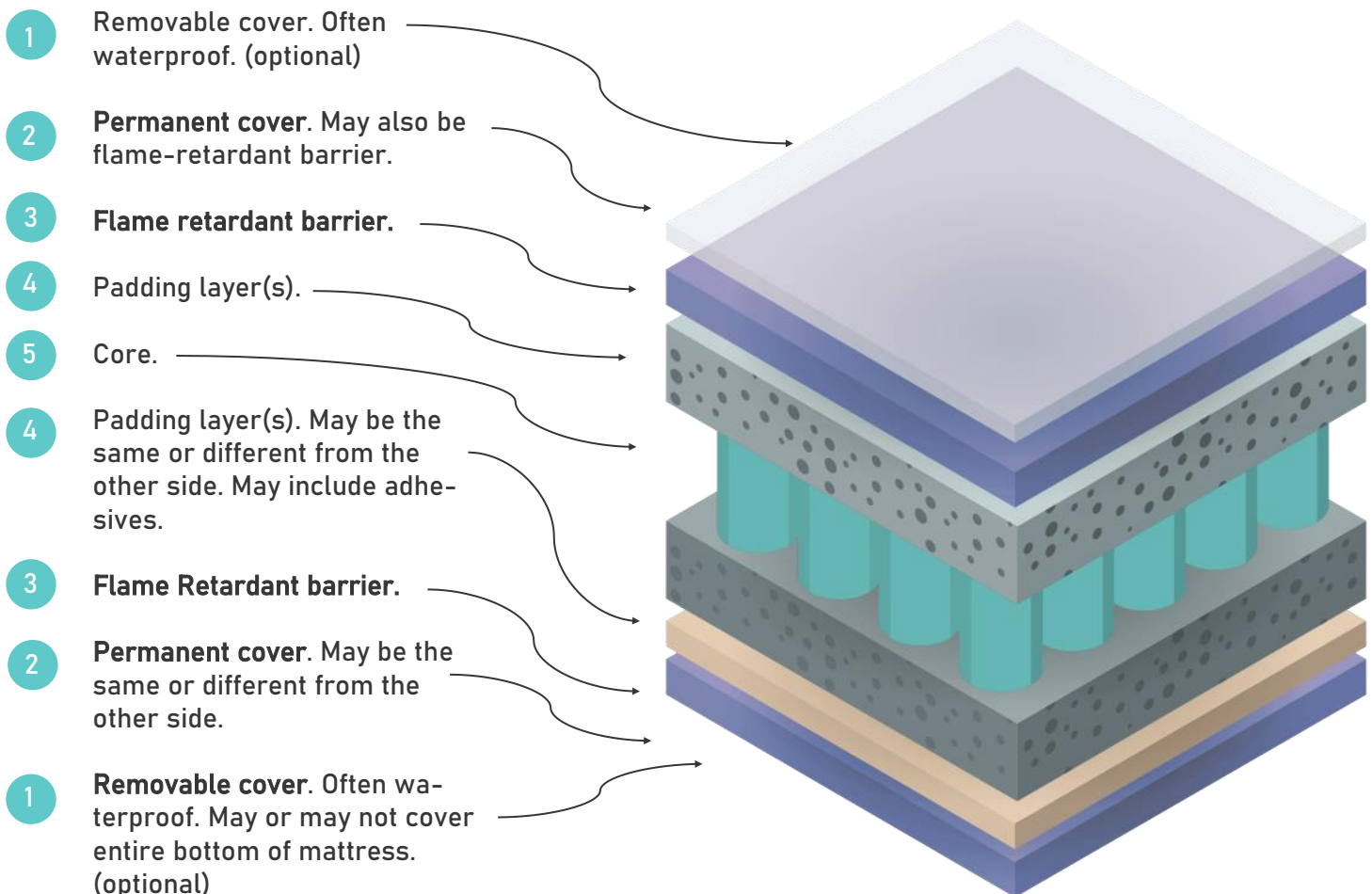
on retailer websites (such as Amazon, buybuy BABY, Target, and others).

This report focuses on two methods for assessing what's in a crib mattress: disclosures from 37 companies on 227 mattress models from online product descriptions and in responses to a survey; and direct product testing of 13 mattresses, each from different brands.

ANATOMY OF A MATTRESS

Mattresses have multiple layers. The decisions manufacturers make about each of these components plays a role in the impact of the mattress on

the environment, on workers making the mattress, and, of course, on babies and toddlers.





1 Removable cover. Nearly a fifth of mattresses included in this survey come with a removable cover, a relatively recent addition. Most often these are machine washable. In addition to base materials like cotton, polyester, nylon, and rayon, there can be waterproof treatments on the top or back, and other additives.

2 Permanent cover, which can also include coatings and backings (chemicals applied to the cover material on one side, the other, or saturating the material, to provide water resistance, antimicrobial, or other real or perceived benefits). Common cover materials include PVC/vinyl, cotton, polyester/PET, polyethylene, rayon, polypropylene, and blends.

Cover coatings include polyethylene, vinyl, polyurethane, PFAS chemicals, and antimicrobial products. Covers may be bound with nylon or cotton thread, or if made of plastic, edges may be heated up to seal the material to itself.

Some permanent “inner” covers are also the flame retardant barrier, including those that include modacrylic.

3 Flame retardant barrier, can be made of cotton, wool, modacrylic, or polylactic acid, and may have additional chemicals added, such as silica, antimony, or ammonium polyphosphate. **Many companies disclose the presence of a barrier without revealing the materials used.**

4 Padding in one or more layers, which may be different on each side of the mattress to provide different firmness levels. Most common materials include polyurethane foam, polyester, wool, cotton, and latex.

5 Core, the primary support and structure for the mattress. Most common materials include steel coils, polyurethane foam, latex, coconut and latex (known as coir), polyester/PET plastic, and polyethylene. Steel coils may have cloth wrappers and foam bumpers for edges in addition to padding layers.

There can be additives to each layer. Adhesives may be used when multiple layers of foam are present. Binding materials for covers can include thread, binding cloth, elastic, and zippers. How a mattress is bound can contribute to its ability to meet flammability tests.

Chemicals of Concern in Crib Mattresses

There is a wide variety of materials used in crib mattresses, and as discussed above, many companies don't fully disclose what they use.

Note that when added to removable covers that are intended to be washed, additives listed here have been shown to wash out, reducing their efficacy (if any) and contaminating the wash water, potentially harming water supplies.

PFAS CHEMICALS

The "F" in PFAS stands for fluorine, and PFAS chemicals make up a huge class of fluorine-based chemicals used for stain and water resistance. Because fluorine creates an incredibly strong bond to carbon, PFAS chemicals are highly stable. For this reason they are known as "forever chemicals."

When PFAS chemicals enter the human body, they build up in the liver and kidneys and may contribute to elevated cholesterol, immune problems, thyroid disease, kidney cancer and testicular cancer.¹²

PFAS has been detected in human blood, semen, and breast milk. PFAS can cross the placenta, exposing unborn children.¹³

A recent study by the Commission for Environmental Cooperation¹⁴ (CEC), a collaboration of the three North American countries, detected PFAS in all waterproof baby mats, pads, and blankets tested and nearly half of bibs tested. PFAS in fabrics can easily enter the body through the skin and inhalation. The Commission tested for the ability of PFAS to transfer to humans, and found that nearly one half of PFAS present in bibs and other children's items transferred in a saliva simulation, and one-fifth transferred in a sweat simulation.¹⁴

While infant and child exposure to PFAS during product use is the most apparent concern, the

manufacturing and disposal—landfilling or incineration—of the chemicals are highly problematic. The entire lifecycle of PFAS releases chemicals of concern into our water and air.

ANTIMICROBIALS

When you see a claim that a crib mattress (or another baby product) is "antimicrobial" you might think this will reduce the likelihood that your baby will get sick. There is no evidence that this is true. In fact, the US Centers for Disease Control have concluded that **there is no evidence that antimicrobials in products or on surfaces reduce disease.**¹⁵ Therefore, adding chemicals for this purpose should be considered unnecessary and suspect.

Staph-Gard: This is a proprietary antimicrobial used by Sealy, and we found no other reference to it. It appears to be the same as "Staph guard,"¹⁶ which is made of quaternary ammonium compounds ("quats"). The Safety Data Sheet¹⁷ identifies risks including allergic skin reactions. Quats can harm sperm quality, and reduce fertility.¹⁸ Breathing in quats in disinfectants can trigger asthma.¹⁹

Nanosilver: Silver is a natural antimicrobial, and has been recognized as such for centuries. Use of nanosilver has increased in a variety of products in recent years, including in apparel to reduce odor-causing bacteria, and in some crib mattress covers. Nanosilver is silver present at a very, very small size (hundreds of times smaller than the width of a human hair). There is some evidence that nanosilver can enter the human body. Laboratory studies have found that nanosilver can harm skin, liver, lung, brain, vascular and reproductive cells.²⁰

Ultra-Fresh is used by one company, and it appears to be use zinc as its active ingredient, but we were unable to find details about the specific product.

PLASTICIZERS

Ortho-phthalates, commonly called “phthalates,” are used in polyvinyl chloride (vinyl), and are endocrine disruptors.²¹ Eight phthalates, including DEHP, DBP, and BBP, have been prohibited in levels above 0.1% in the U.S. for children’s toys and child care products, including crib mattresses.²² Our testing did not find any banned phthalates.

Non-orthophthalate alternatives, such as dioctyl terephthalate (DOTP or DEHT) and 1,2-cyclohexane dicarboxylic acid, diisononyl ester (DINCH), have been commonly used in the years since phthalates have been restricted by government regulations. DOTP and DINCH are considered safer alternatives to phthalates. But, **new research showing DOTP interacts with hormone receptors raises concerns about the chemical’s possible endocrine activity.**²²⁻²⁵ Additionally, DINCH has been shown to affect hormones and the reproductive system and to alter testosterone production. Research shows DINCH can also affect glucose levels and liver and kidney function.²⁶

We have little to no toxicity data for other non-phthalate alternatives, such as B2EHA (adipate), ASE (alkyl sulfonic acid ester, Mesamoll®), EHDP (2-Ethylhexyl diphenyl phosphate), benzoate esters (such as Benzoflex™).

FLAME RETARDANTS

Flame retardant (FR) chemicals have been added to consumer goods, like mattresses, as a less-expensive method for meeting governmental flammability standards. By using certain fabrics and

designs, however, manufacturers can meet flammability standards without chemicals. **Most flame retardant chemicals easily migrate out of the parent material (fabric or foam) and become airborne via dust.**²⁷ Human exposure may occur through **breathing or ingesting dust and even through the skin.** There are several types of flame retardants:

Halogenated flame retardants include brominated and chlorinated chemicals, which don’t break down easily in the environment. Chemical persistence can lead to bioaccumulation, the buildup of a substance in people and animals. Many halogenated flame retardants are known endocrine disruptors, can harm brain development, disrupt fetal and child development, and some are linked to cancer.²⁸

Phosphorus-based flame retardants are made without halogens and have increased in popularity as the health and environmental concerns about halogenated flame retardants have grown. Triphenyl phosphate (TPHP) is one example of a widespread phosphorus-based flame retardant. TPHP is found extensively in the environment and accumulates in breast tissues.²⁹ It exhibits hormonal and developmental toxicity.³⁰⁻³² Ammonium Polyphosphate is another alternative for which little data is available.

Antimony trioxide is not a flame retardant on its own, but acts as a synergist. When used in combination, antimony trioxide enhances the effectiveness of other flame retardant chemicals, such as halogens. Antimony is also a catalyst used in the production of polyethylene terephthalate (PET) plastic. Antimony trioxide is considered possibly

There are five key kinds of chemicals to avoid in crib mattresses: PFAS chemicals, antimicrobials, vinyl, flame retardant chemicals, and heavy metals. Polyurethane foam should also be avoided.

carcinogenic to humans (Group 2B) by the International Agency for Research on Cancer and reasonably anticipated to be a human carcinogen by the National Toxicology Program.³³

Modacrylic materials are 35–85% polyacrylonitrile,³⁴ reacted with polyvinyl chloride,³⁵ or polyvinylidene chloride.³⁶ The precursor chemicals for modacrylic appear on numerous Restricted Substances Lists identified by the Pharos Project.

Other flame retardant chemicals include organonitrogens, and materials used at the nanoscale. We did not identify these in crib mattresses, but this does not mean they are not present.

Heavy Metals may be present in crib mattresses as contaminants or added purposefully as flame retardants or for other uses. Heavy metals like antimony, lead³⁷ and cadmium,³⁸ can harm nervous systems and brain function. As infants and young children are still developing, heavy metals can have a more potent impact than on adults.

Volatile Organic Compounds can easily enter our air, where they can irritate eyes, nose, and throat, harm the liver, kidneys, and central nervous system and contribute to cancer. They can be found in adhesives, polyurethane foam, paints, furnishings, and more.³⁹

GREEN CLAIMS TO WATCH OUT FOR

- “Soy foam,” “infused with plant oil,” and “plant-based foam” can actually refer to polyurethane foam. Adding plant oils to the formulation doesn’t change the other problematic chemicals used to make the material.
- Low VOC tests like UL’s GreenGuard or GreenGuard Gold do not mean a product is nontoxic, or even that it will not add any VOCs into the nursery.
- “Organic” claims that A) have no certification logo from GOTS or GOLDS, B) only apply to one component may not result in an inherently safer mattress. Even organic cotton certified as an agricultural product by the USDA can be processed with harmful chemicals.
- Single layers of slightly preferable materials are often promoted to justify a higher price, while the remainder of the mattress is not better for the planet or babies.
- “Nontoxic,” “ecofriendly,” etc. — these catch-all phrases have no legal definition, and in order to be meaningful need to be backed up by verifiable certifications from third parties, such as GOTS, GOLDS, and MADE SAFE®.

[Learn more about certifications on page 24.](#)



PLASTICS AND FOAM: NOT ALL ARE CREATED EQUAL

Most plastics and foams start out as fossil fuels—oil and gas extracted from under the earth—that are refined and reacted with other chemicals, then blended and processed into different materials. Final products like polyurethane, polyester, and polyvinyl chloride (also called vinyl or PVC) include the primary chemical as well as additives, byproducts, unreacted precursors and contaminants.

Polyvinyl chloride⁴² (**vinyl**) relies on bisphenol A early in its production. Additives give color, and make it flexible or rigid. Some of those additives are phthalates. Its basic building block, vinyl chloride, can cause cancer and other major health problems.⁴³ In the event of a house fire or disposal in an incinerator, the presence of chlorine means it releases highly toxic dioxins and furans, as well as forming hydrochloric acid.⁴⁴

Polyurethane is typically made by blending petroleum-derived oils and isocyanates,⁴⁵ which have been shown to harm the lungs of production workers, and which may also cause cancer. To make polyurethane foam, additional chemicals are added, making up 10% of the foam. These include ethanolamines, surfactants, blowing agents, catalysts, volatile organic compounds, and more.⁴⁶ Some of these have been flame retardants, intended to slow down the start of polyurethane burning. Due to changing laws, companies have changed how they achieve flammability standards.

A number of crib mattress companies highlight “plant-based” or “soy foam” because the oil (also called polyol) part contains an unknown but usually

small amount of soybean or castor oils which is highlighted as an eco-friendly benefit. It does not eliminate synthetic isocyanates, blowing agents, or other additives and the overall product is still primarily fossil-fuel based. This change represents a small tweak, not the fundamental changes needed to protect human health and our planet.

Thermoplastic polyurethane (TPU) is used as a waterproof coating. In that situation, despite the same polyol-isocyanate chemistry for production, it does not contain as many additives, and is considered preferable to polyvinyl chloride covers and coatings, or PFAS chemicals.

Polyethylene terephthalate (PET) is the same material as **polyester**. It is made from petroleum, and is commonly made using antimony as a catalyst⁴⁷, which remains in the final product.

Polypropylene (PP) is made from petroleum, has relatively few additives, and can be used as a waterproofing layer.

Use of **polyethylene (PE)** as a foam or waterproof coating is relatively recent. Typically, polyethylene requires fewer additives than PVC. Polyethylene can be high density (HDPE, in solid form marked with a #2 for recycling) or low density polyethylene (LDPE, marked as #4 for recycling).

Most polyethylene comes from fossil fuels, but some is now being manufactured from sugar cane as its full feedstock. This represents a significant redesign, and depending on how the sugar cane is grown, can be a much more preferable option.

Non-chlorinated plastics are safer than chlorinated, and polyethylene or PET interiors embody less toxicity than polyurethanes, whether or not they contain flame retardant chemicals.

What's in a Mattress: Company Disclosures

Clean and Healthy New York identified crib mattress models and brands in 2018, and reviewed the product description information provided by 37 companies on their websites as our primary source several times including in mid-2019 and early 2020. In fall 2019, we sent letters to each company ([see Appendix II](#)) requesting clarity on materials used.

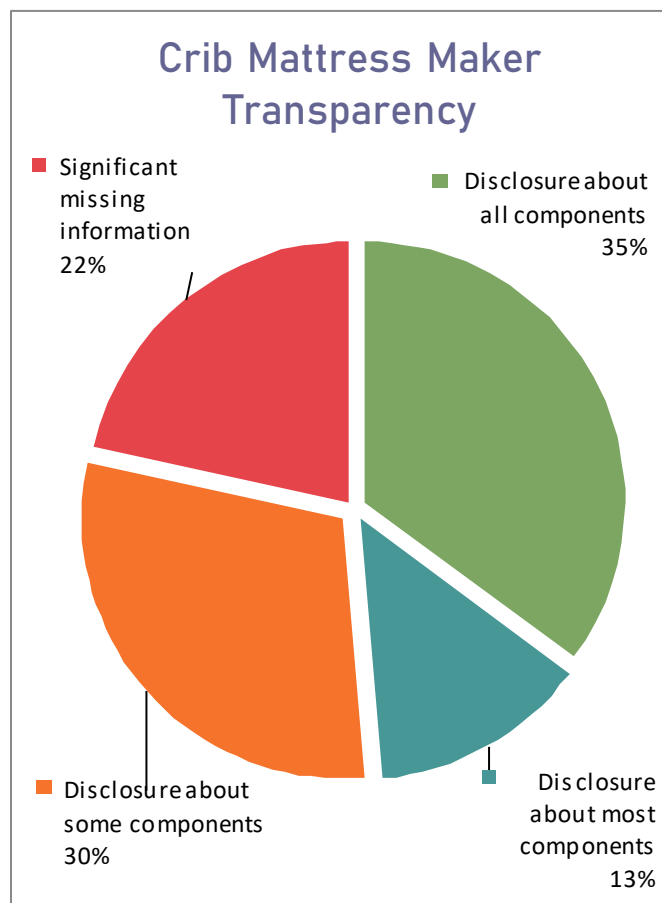
We received at least partial responses from 12 companies: Babyletto, Brentwood Home, Colgate Mattress®, Kolcraft®, Lullaby Earth™, Moonlight Slumber™, Naturepedic®, Nook Sleep, Oeuf, Sealy, Stearns & Foster, and White Lotus Home. That information is included when it was provided.

For 13 mattresses, we offer an additional source of information: laboratory testing, led by the Ecology Center. [See page 19](#) for those methods and results.

For those products for which samples were purchased, we also inspected the marketing materials included with the mattress and the information provided on the legally required tags.

We sought to identify the materials used in each component of the mattresses, with keen interest in materials and chemicals used for cover, waterproofing, padding, and core materials, and barriers for flame resistance (or other mechanisms for meeting the same). When we queried companies directly, in addition to filling in broad gaps (such as the type of flame barrier used or cover material) we sought to clarify the specific chemical additives that might be present in certain material types, such as plasticizers in vinyl, and vinylidene chloride in modacrylic.

We are reporting results from all crib mattress brands whose product information we reviewed, whether or not they replied to our direct request for information. **What we found was a wide range of company transparency and materials choices.**



You can spend between \$50 and \$250 and end up with essentially the same product: vinyl (with lots of undisclosed additives) wrapped around various types of polyurethane foam (with its own additives).

Crib mattresses vary widely in materials and cost. The least expensive is \$36, and the most costly is \$786. The average mattress price is approximately \$190, while the median price is \$150.

There is a wide range of transparency from companies. To assess completeness, we tallied the number of specific answers to the categories of our questions: the cover material; if it is waterproof, what made the cover so; if antimicrobial, what material made it so; what material(s) and chemicals were used to meet flammability standards; the core material(s); and the padding layer(s) if any.

Thirteen companies—35% of those surveyed provide information about each of these categories: Babyletto, Lifekind®, Lullaby Earth™, My Green Mattress, Naturepedic®, Newton Baby®, Nook Sleep, Obasan, OMI®, Savvy Rest, SleepLily, Soaring Heart, and White Lotus Home.

A further five companies (14% of those surveyed) provided information about most of the components, with an average per model of one or fewer missing component materials: Delta Children, Foundations®, Ikea®, Oeuf, and Sealy™.

Eleven companies (30% of those surveyed) provided only some information, with an average per model of between one and two undisclosed component materials: Bloom Baby, Brentwood, Bundle of Dreams®, Child Craft™ Baby, Colgate Mattress®, Graco®, Kolcraft®, Safety 1st®, Serta™, Simmons Kids®, and Stears & Foster™.

Eight companies (22% of those surveyed) had significant missing information, with an average of more than two of six undisclosed component materials: AFG Baby Furniture, DaVinci Baby, Kidi Comfort™, LA Baby, Millard Bedding, and Moonlight Slumber™.

MATERIALS BY COMPANY DISCLOSURE

Covers

Of the crib mattress models surveyed, 43 have removable covers, essentially taking the place of mattress pads. This is a relatively new approach, in part made possible by the move from adding flame retardants in foam to creating a barrier layer, which in some cases, serves as the inner cover.

For 64 models, companies did not fully disclose at least one aspect or material in their covers.

The most common materials manufacturers said they used in covers are as follows (Note: total is more than 100% as covers can include more than one material):

- **For 38% of all mattresses surveyed, manufacturers disclose using cotton.** 23 of 37 compa-

nies disclosed this.

- **For 37%, companies disclose using polyester (PET).** 12 companies disclosed this.
- **For 27%, companies disclose using polyvinyl chloride (PVC).** 11 companies disclosed this.

Less common materials include conventional rayon (disclosed in 8% of mattresses), lyocell rayon (6%), polyethylene (3%), nylon (3%) and modacrylic and wool (less than 1%).

For 5% of mattress models, manufacturers disclosed adding minerals of some kind—silver, a combination of minerals, or zinc.

There is still significant absence of information, however: **There was one or more unknown element for 28% of the mattresses we assessed.**

Healthier options: Cotton, especially GOTS certified organic, lyocell rayon, wool.

Less preferable: Vinyl, modacrylic, conventional rayon, or unknown.

Waterproofing

Most mattresses are made to be waterproof or water resistant. Only 19% of mattress models surveyed are clearly made without waterproofing.

One change from the past is the increase of waterproof backings rather than waterproof surfaces. 33% of mattresses had water resistance on the surface, 25% had water resistant backings.

- **When assessing the actual material, we could not determine water resistance materials for 37% of the mattresses.**
- **Vinyl was the most common material disclosed (21%),** followed by polyurethane (10%), and polyethylene (8%).
- **PFAS chemicals were disclosed for 9 products, made by 3 companies.**
- Other water resistance materials include nylon and rayon.

One company, LA Baby, discloses on their website FAQ that they treat mattress covers with DuPont's Teflon Fabric Protector.⁴⁸ They do not disclose their waterproofer in product descriptions.

Healthier options: No waterproofing, polyethylene (particularly when made from sugarcane).

Less preferable: Vinyl, PFAS.

Antimicrobials

Seven companies claim their products are antimicrobial. Four of those companies (covering 11 products) do not provide details on what chemicals or materials are antimicrobial. Eleven products from one company contain zinc in their covers, one contains silver, and one called "Staph-Gard."

Healthier options: No antimicrobial additives. In crib mattresses, they don't deter the growth of disease-causing microbes.

Flame retardants

A decade ago, most mattress companies met federal flammability standards by adding chemicals to padding or polyurethane foam cores. With changing state laws banning certain FR chemicals, shifts in state regulations, and increased public demand for safer products, crib mattress makers report using barriers or redesigning their products to meet flame resistance requirements.

- **12% of mattresses surveyed report meeting FR standards through materials and design, without flame retardant chemicals.**
- 67% reportedly use barriers.
- **22% did not disclose any details about FRs.**

The most commonly reported FR barrier material was cotton (53 mattresses, 23% of models). This may include added chemicals that were not disclosed; no company responded to requests for more details. Of those reports, 8 models use GOTS certified organic cotton.

15% of mattresses use hydrated silica. Eight mattresses made by Nook Sleep have the silica bonded to rayon. Sealy™ reports its 24 models with silica bonded to "cellulose." Brentwood does not disclose to what material silica is bonded in its three models.

Rayon is reported as an FR barrier in 8% of mattress models by three companies. Wool is used in 7% of models by nine companies. Polyester is used in 4% of mattresses by two companies. Polylactic acid (PLA) and cotton are reported in 3% of mattresses by one company, Naturepedic®. One company, Newton Baby®, adds a phosphorus-based compound to its PE core. One company, Bloom Baby, reports using ammonium polyphosphate.

Healthier options: Organic cotton, wool, polylactic acid, overall mattress designed to avoid specific FR.

Less preferable: Modacrylic, phosphorus, unknown materials.

Padding

- **27% of mattresses include polyester/polyethylene terephthalate (PET) fibers.**
- **25% have a polyurethane foam layer.**
- For 24% of mattresses, manufacturers report no padding layers.
- 12% of mattresses contain cotton in one or more padding layers.
- Latex, coir, wool and rayon are also used as padding.
- **14% of mattresses contain padding layers but manufacturers didn't identify the material.**

Healthier options: Organic cotton, wool, no padding. If latex allergies are not a concern, latex and coir.

Less preferable: Polyurethane foam, unknown materials.

Core

Despite new options on the market, polyurethane foam and steel coils still make up two thirds of all crib mattress cores, according to company disclosures.

- 34% of surveyed mattresses have polyurethane foam cores.
- 32% have steel coil cores.
- 16% have polyester/PET cores.
- 7% have latex in their cores (4% use that latex to bind coir).

Polyethylene is another relatively new material, now comprising 5% of mattresses surveyed. Cotton batting makes up 3%, wool 2%.

Manufacturers failed to disclose the core material in only 3% of mattresses surveyed.

Healthier options: Steel, latex, particularly GOLS certified organic latex (unless latex allergies are a concern), cotton, wool, sugar-based polyethylene.















Less preferable: Polyurethane.



Alphabetic within each section

SUMMARY OF DISCLOSED MATTRESS MATERIALS

NAME	# OF MODELS	COVER	COATING	FLAME RETARDANTS	PADDING	CORE
Lifekind®	2					
My Green Mattress	1					
Naturepedic®	6					
Obasan	11					
OMI®	2					
Savvy Rest	1					
Sleep Lily	2					
Soaring Heart	1					
White Lotus Home	3					
Bloom Baby	2					
Lullaby Earth™	4					
Newton Baby®	3					
BabyLetto	5					
Bratt Décor®	3					
Brentwood	3					
Bundle of Dreams®	1					
DaVinci Baby	2					
Graco®	2					
Ikea®	5					
KidiComfort™	5					
Nook Sleep	11	 				
Oeuf	2				 	
AFG Baby	4					
Child Craft™ Baby	1					

NAME	# OF MODELS	COVER	COATING	FLAME RETARDANTS	PADDING	CORE
Colgate Mattress®	24	           	    	  	      	  
Delta Children	3					
Dream on Me	11				 	  
Foundations®	3					
LA Baby	6	  	 	  	  	 
Millard Bedding	3	 			 	 
Moonlight Slumber	9	  	   	 	  	    
Simmons Kids®	11	  	  	 	 	 
Kolcraft®	8	  	 		 	 
Safety 1st	8	   	 		  	   
Sealy™	42	  	   	  	    	  
Serta™	22	  	 	 	  	  
Stearns & Foster™	2	  	 		    	

KEY FOR DISCLOSED MATTRESS MATERIALS



WOOL



COTTON



COIR



LATEX

LYOCELL
RAYON

STEEL

POLYLACTIC
ACIDPOLY-
ETHYLENEPOLY-
PROPYLENE

NONE

PHOSPHORUS-
BASED FLAME
RETARDANTS

MINERALS



SILICA



NYLON



RAYON

POLYETHYLENE
TEREPHTHALATE

MODACRYLIC

PER- & POLY
FLUOROALKYL
SUBSTANCESPOLY-
URETHANEVINYL
POLYVINYL
CHLORIDE

UNKNOWN

Full disclosure,
safe materialsSignificant dis-
closure, safer
materialsIncomplete disclo-
sure, fewer safer
materialsIncomplete disclo-
sure, chemicals of
concern presentMix of materials
and disclosure
within brand

What's in a Mattress: Test Results

The Ecology Center's Healthy Stuff Lab tested one mattress from each of 13 companies for chemicals of concern using five different analytic methods. Mattresses were selected to capture a range of price points, popular brands, and styles.

Chemicals included: 19 phthalate and non-phthalate plasticizers, 82 flame retardant chemicals, total fluorine indicative of PFAS as well as 43 individual PFAS compounds, and a range of elements, including metals and halogens. More detail on analytical methods used is available in the methods section. Healthy Stuff Lab also identified the polymer or fiber type of each mattress component.

Plastic or Fiber Type

We tested the mattress components to identify material composition, for example: polyester fabric, polyethylene (PE), polyurethane (PU) foam, polyvinyl chloride (vinyl). This allows us to determine whether a given chemical of concern is typically found in a certain type of material. For example, pure vinyl is brittle and requires plasticizers to make it flexible and give it other qualities.

Plasticizers are additives used to increase the flexibility of plastics, particularly vinyl. We tested for:

- Ortho-phthalates
- Dioctyl terephthalate (DOTP or DEHT)
- 1,2-cyclohexane dicarboxylic acid, diisononyl ester (DINCH)
- Adipate (such as B2EHA)
- Alkylsulphonic phenyl ester (ASE)
- 2-Ethylhexyl diphenyl phosphate (EHDP)
- Benzoate ester

Flame Retardants can be added to foam, plastic, or barriers. We tested for:

- Halogenated flame retardant chemicals
- Non-halogenated flame retardant chemicals

- Phosphorus-based flame retardants
- Antimony-based flame retardant

PFAS chemicals: We tested for elemental fluorine, and followed up with additional tests to identify certain PFAS chemicals.

Heavy metals: We tested for lead, cadmium, mercury, and antimony.

RESULTS

Crib mattress covers

Mattress covers were tested to identify material type and the presence of other detectable chemical hazards.

Vinyl and Plasticizers

Almost half (6 of 13) crib mattresses had polyvinyl chloride covers. All six had one or more plasticizer.

Plasticizer chemicals are added to vinyl to make it pliable. We found five different plasticizers:

- Four covers contained DOTP as the primary plasticizer. Two of these also had a relatively low level of B2EHA.
- Two covers contained DINCH and ASE. ASE has almost no toxicity data. It has been measured in German daycare dust.⁴⁹
- Two of the vinyl covers (Safety 1st and Serta™) contained EHDP.

The non-vinyl covers were mostly polyester fabric (PET). Some were backed by another material: polyurethane, acrylic, and cotton.

PFAS testing

All of the mattress covers were tested for total fluorine (F) by particle induced gamma ray emission (PIGE). Three of the covers (Colgate Mattress®, and

discontinued models made by Nook Sleep and Safety 1st) had total fluorine levels suggestive of PFAS. Two of these were vinyl covers. The levels are likely high enough to represent an intentional PFAS-based treatment for waterproofing, although the results were not conclusive.

Testing at Indiana University confirmed certain PFAS compounds in those three covers: The Nook Sleep cover showed the highest level, 222 parts per billion (ppb) of PFAS, most of which was the telomer alcohol FHET. The Safety 1st cover showed 12 ppb of this same compound. Colgate Mattress® results showed 0.49 ppb. The levels differ from the total fluorine levels because not all PFAS were detected by the Indiana University testing.

Four additional mattresses (from Dream on Me, Foundations®, L.A. Baby, and Serta) had lower fluorine levels unlikely to represent intentional use. The source could be residual PFAS chemicals used in manufacturing. L.A. Baby discloses use of a PFAS waterproofer, which would typically result in fluorine levels higher than that found in our test of one L.A. Baby cover. The reason for this discrepancy is unknown.

Flame Retardants

Two of the PVC covers contained antimony at levels very likely to indicate antimony trioxide as a flame retardant. The two companies were Foundations® and Dream on Me.

Two of the PVC covers (Safety 1st and Serta™) contained 411 and 143 parts per million (ppm) EHDP (2-Ethylhexyl diphenyl phosphate), respectively.

Fire barriers

Mattresses with PU foam cores had fire barrier wraps. The barrier wraps were composed of a variety of polymers and fibers, including rayon/cellulose, PVC, and PET. Two of these fire barriers contained elevated antimony.

Mattresses with polyester fiber cores or polyethylene-based cores did not have fire barrier wraps.

One of the mattresses with metal springs (Colgate Mattress®) had a nonwoven wrap and two layers of padding made of polyester/rayon. One of these padding layers contained elevated antimony.

Crib mattress cores and padding

Crib mattress cores represent the bulk of mattress materials by volume. There were four main core types: three types of plastic polymers and metal. Fourier-transform infrared spectroscopy (FTIR) was used to identify the polymer used for each non-metal mattress core. Mattress cores:

- 6 polyurethane (PU)
- 3 steel coil
- 2 polyester fiber
- 2 different types of polyethylene (PE) cores:
 - Newton Baby® uses breathable PE network.
 - Naturepedic® uses PE foam.

Several additional analytical methods were used to identify chemicals of concern in these polymers.

Two mattress cores were identified with flame retardants.

- The **L.A. Baby** - Triple Zone 2-in-1 Soy Foam had elevated bromine (Br) and chlorine (Cl) at levels in the PU foam that could be consistent with the presence of halogenated fire retardants, but we were unable to determine the sources of this Br (0.2%) and Cl (4.4%). The “egg crate” part of the foam core also was found to contain an aryl phosphate. Mass spectrometry at Indiana University confirmed the foam contained 559 ppm triphenyl phosphate and 300 ppm tris(4-tert-butylphenyl phosphate).
- The **Newton Baby®** PE network core contains phosphorus but we were not able to fully identify the specific flame retardant.

Mattress cores were also analyzed for individual PFAS chemicals. No detection of PFAS compounds above 10 ppb were found, although low ppb were found in all cores tested.

See Appendix I on page 35 for more information.

DISCLOSURE AND TEST RESULTS OF CHEMICALS OF CONCERN

A comparison of test results and company product description disclosures for three key components: Cover (including waterproofing), FRs (in barriers or cores), and core. Note: All vinyl contained undisclosed plasticizers.

NAME	MODEL	COMPARISON	PU FOAM	FRs	PFAS	VINYL
Naturepedic®	Classic, wave support core	All components match claims. Safe materials	No	None	No	No
Ikea®	Pelleplutt Foam for Crib	Cover, core match claims. Undisclosed rayon, PET FR barrier.	Yes	Safer materials	No	No
Moonlight Slumber™	Little Dreamer™ Dual Sleep Surface Crib	All components match claims.	Yes	Safer materials	No	No
Newton Baby®	Standard	All components match claims. Core contains phosphorus FR	No	Phosphorus-based	No	No
Sealy™	Baby Firm Rest Crib	FR, core match claims. Safer materials. Undisclosed vinyl cover with PET backing	No	Safer materials	No	Yes
Serta™	Nightstar™ Standard Support Crib	FR, core match claims. Undisclosed vinyl cover	No	None apparent	Possible	Yes
Dream on Me	Twilight 5-inch Coil Spring Crib and Toddler	FR, core match claims. Undisclosed vinyl cover contains antimony	Yes	Antimony indicates FRs	No	Yes
Foundations®	Infapure 4-inch Full-Size Crib	FR, core match claims. Undisclosed vinyl cover contains antimony	Yes	Antimony indicates FRs	Possible	Yes
Safety 1st	Little Dreamer Baby Crib*	FR, core match claims. Vinyl cover contains undisclosed PP, PFAS	No	None apparent	Yes	Yes
Graco®	Premium Foam Crib & Toddler Bed	Core matches claims. Test results contradict claims of no antimony in FR barrier. Undisclosed cotton, vinyl, nitrile in FR barrier.	Yes	Antimony indicates FRs	No	Yes
Nook Sleep	Pebble Lite Crib*	FR matches claims. Cotton & PET cover contains undisclosed PFAS. PU foam core contains undisclosed chlorine. Disclosed PET "Air spacers" contain undisclosed neoprene, plasticizer.	Yes	Chlorine indicates FRs	Yes	No
Colgate Mattress®	Royale Crib	No matches. Vinyl cover has undisclosed PFAS. Undisclosed FR contains antimony. Metal spring core has undisclosed padding with chlorine	No	Antimony, chlorine indicate FRs	Yes	Yes
L A Baby	Triple Zone 2-in-1 Soy Foam Crib	No matches. Company disclosed cover has PFAS, tests found likely. Cover also contained undisclosed PU, acrylic. FR barrier has undisclosed PET, nitrile, vinyl, rayon, antimony. PU foam core has undisclosed bromine, chlorine, phosphorus	Yes	Chlorine, bromine, phosphorus indicate FRs	Possible	Yes

* The model tested has been discontinued.

KEY:

FR = Flame retardant. PFAS = Per and polyfluoro-alkyl substances. PU = Polyurethane. PP = Polypropylene. PET = Polyethylene terephthalate

Match, and/or safer chemicals

One mismatch, or one chemical of concern

2+ mismatch, or chemicals of concern present

What's in a Mattress: Reconciling Testing and Disclosure

For the 13 products tested by Ecology Center, we compared online product description disclosures with the results from laboratory testing. **The information and test results matched for only six of the 13 products tested (46%), and only two provided full information verified by our tests.**

Naturepedic® Lightweight Organic Cotton Classic Crib mattress and **Newton Baby®**'s crib mattress provided meaningfully complete descriptions of all three layers tested that matched lab analysis.

Ikea® Pelleplutt, **Serta™** Nightstar™ Standard Support, **Moonlight Slumber™** Little Dreamer, and **Sealy™** Baby Firm Rest Crib mattresses provided incomplete information but all available information matched.

Seven companies had undisclosed chemicals of concern in their products.

Foundations® InfaPure mattress materials matched, but had undisclosed antimony in its vinyl cover.

Dream on Me did not reveal its cover material. Testing identified it as vinyl, containing DOTP, antimony, and chlorine.

L.A. Baby's Triple Zone 2 in 1 Soy Foam with Blended Organic Cotton Cover Crib Mattress contained a cotton cover backed by polyurethane and acrylic, while the company says the cover is organic cotton. We detected levels of fluorine too low to indicate intentional use for waterproofing, though the company states that they use a PFAS treatment on their covers. The company failed to disclose the content of their FR barrier. Testing found PET, nitrile, vinyl, rayon and antimony. The company claims the core is made of polyurethane and polyester. Testing found poly-urethane with organophosphate FRs, as identified with FTIR and GCMS.

Colgate Mattress® Royale Crib Mattress contains undisclosed fluorinated chemicals in the cover. No

flame retardant material was identified by the company, but inner padding contained antimony. Chlorine was identified on the inner padding, indicating a chlorinated flame retardant may be present.

Graco® Premium Foam mattress did not provide information about its cover material. Testing identified PET backed by polyurethane. The company stated no chlorine or antimony in its barrier but antimony was detected, along with vinyl and polyacrylonitrile.

Nook Sleep's Pebble Lite mattress was purchased and its webpage reviewed before it was discontinued. The company identified numerous materials in the cover. We found PET backed by cotton. The company claimed the surface was water resistant due to lyocell rayon and cotton, but we found fluorine, suggesting PFAS chemicals. The company disclosed that the flame barrier was made by Freudenberg, and we found a matching non-woven wrap of PET and rayon. The core is polyurethane foam, matching company claims. Additionally, the company identified "recycled PETE air spacers" which also contained neoprene (a chlorinated polymer), and a benzoate ester plasticizer, also found in the foam.

Safety 1st claimed its Little Dreamer Baby Crib mattress (model now discontinued) cover was made of vinyl. Testing found vinyl with DOTP backed by PET. In addition, we found fluorine, indicating PFAS, at 12 ppm. The PET fire barrier and steel coil core match company disclosures.

The conflicts between what companies disclose and what testing reveals is troubling for families seeking a safe and healthy crib mattress. Especially troubling is the unreported presence of PFAS, and likely presence of banned FR chemicals in foam.

Finding the Safest Mattress on Any Budget

To ensure a healthy start in life, all babies deserve safe sleep spaces, free of harmful chemicals, regardless of what families can afford to spend.

When Clean and Healthy New York conducted a similar market survey in 2011, 40% of crib mattresses had vinyl in the covers, compared with 27% in this survey. In 2011, only one company (**Naturepedic®**) offered a polyethylene core, and now two more companies do (**Lullaby Earth™** and **Newton Baby®**). In addition, ten companies offer polyester/PET cores, when none did in 2011.

To understand what options people with different economic resources have, we assessed the low and high end of cost spectrum.

53 of the mattresses we surveyed cost \$100 or less, with the lowest-cost mattress only \$36. We matched that sample with the 53 most expensive mattresses, which ranged in price from \$249 to \$786, with an average price of \$356.

Within the low-cost mattresses, 64% contain one or more chemicals of concern (vinyl, FRs, anti-microbials, PFAS), 25% don't provide enough information, and 32% have polyurethane foam cores.

Within the high-cost mattresses, 32% are substantially without petroleum-based materials. Only 28% contain one or more chemicals of concern, but 28% did not provide enough information. **Despite prices that are over \$350, 34% of high-cost mattresses are made with polyurethane foam.**

CHOOSING SAFER OPTIONS

Unlike in the past, based on company disclosures, it appears possible to get a mattress made without vinyl, PU foam, PFAS or added FRs for less than \$100. The following two mattresses from **Sealy™** meet the above criteria, but do use a polyurethane laminate (PUL, preferable to vinyl or PFAS, but less

preferable to polyethylene or polypropylene):

- EverLite™ 2-Stage crib mattress \$99.
- Premier Posture™ 2-Stage crib mattress \$99.

The **Safety 1st®** Grow with Me 2 in 1 Mattress (offered for \$42-\$58) appeared to be made without those chemicals and also free of PUL. This demonstrates that such a safer product can be offered. Unfortunately, it has been discontinued.

There are a number of products that companies disclose are either made with safer covers (polyethylene and cotton) or with alternatives to polyurethane foam cores, but not both—this highlights the opportunity and possibility for manufacturers to adopt low-cost, safer solutions and expand those offerings.

10 mattresses don't rely on petroleum and avoid all chemicals of concern, and are certified as such.

These are all among the most expensive — made from plant- or animal-based materials that are part of certified organic mattresses. These are:

- **Lifekind®** Innerspring and Natural Latex mattresses. (GOTS & GOLS certified organic.) \$599.
- **Naturepedic®** Organic Breathable 2-Stage Innerspring and Organic Cotton Classic- 2-Stage Innerspring crib mattresses. (Both are GOTS & MADE SAFE® certified.) \$379 and \$299 respectively.
- **Obasan** Organic Latex Crib Mattress (GOTS & GOLS certified). \$299.
- **OMI®**'s Certified Organic Quilted Innerspring and Organic - OrganicPedic® - Natural Rubber and Innerspring crib mattresses. \$599.
- **Soaring Heart** Organic Crib Mattress. \$419.
- **White Lotus Home** Organic Cotton and Organic Cotton & Wool Crib Mattress. \$786.

Manufacturers reported that the following mattresses are made without vinyl, polyurethane



foam, added flame retardants, PFAS, anti-microbials, or added minerals. Those with polyester/PET almost certainly contain antimony.

Lullaby Earth™ (MADE SAFE® certified)

- Healthy Support Waterproof Crib 1-Stage. \$169.
- Healthy Support Waterproof 2-Stage Crib. \$199.
- Wisp Air Breathable Crib. \$199.
- Breeze Air Breathable 2-Stage Crib. \$259.

Naturepedic® (GOTS and MADE SAFE® certified)

- Organic Cotton Classic –Lightweight. \$349.
- Breathable Ultra 2-Stage Organic. \$399.

My Green Mattress® Emily Natural Crib. \$289.

Oeuf Pure & Simple Organic & Natural Crib. \$395.

While meeting the above criteria, **Sealy™** discloses that their relevant models' covers have a waterproof polyurethane backing:

- Naturally Firm™ Foam 2-Stage. \$105.
- OmniPlush™ Crib & Toddler. \$120.
- Cotton Comfort™ 2-Stage Crib & Toddler. \$130.
- Cotton Cozy Rest™ 2-Stage Crib & Toddler. \$130.
- FlexCool™ 2-Stage Crib & Toddler. \$130.
- Healthy Dream™ Hybrid 2-Stage Crib & Toddler. \$140.
- OptiCool 2-Stage™ Crib & Toddler. \$150.

- BabyPedic™ Posture Supreme 2-Stage Crib & Toddler. \$150.
- Posturepedic® Crown Jewel™ Luxury Firm Crib & Toddler. \$170.
- Baby Posturepedic® Natural Nights. \$180.
- Naturalis™ Hybrid 2-Stage Crib & Toddler. \$180.

TESTING AND FULL DISCLOSURE

There may be more mattresses that are made without harmful chemicals, but many manufacturers do not provide full information. They must detail ingredients, provide links to verify any claimed certifications. The advent of websites allows for extensive disclosure, and crib mattresses are large enough that labels can also be clear and specific.

This is also highlighted by some of the conflicts between disclosures and testing presented on page 19 and 20, and the table on page 21. For example: based on company disclosure, Nook Sleep reports that their covers are made without chemicals of concern. However, testing of a cover included on an older model found the presence of PFAS chemicals.

Certifications

There are a surprisingly large number of certification programs used to verify a wide range of product qualities. In this section, we highlight the most common certifications claimed by crib mattress makers. We identify companies in this section when we have confirmed they hold certifications for whole crib mattresses (not just components) in the name of the mattress manufacturer (not in the name of suppliers). Other companies may also hold these certifications, but we were not able to publicly verify those claims.



MADE SAFE® is an independent non-profit organization that provides a human health-focused certification for nontoxic products, from baby to personal care to household and

more. To earn the certification, products must not contain known carcinogens, behavioral developmental, or reproductive toxicants, endocrine disruptors, flame retardants, neurotoxins, high risk pesticides, toxic solvents, VOCs, or nanoparticles. If grown, they must not involve genetically modified organisms. Chemicals are also screened to ensure they do not bioaccumulate or persist in the environment. Certified products are listed on their website.

Learn more: www.madesafe.org

Crib mattresses made by Lullaby Earth™ and Naturepedic® are MADE SAFE® certified.

ORGANIC CERTIFICATIONS

Only companies that are verified on the GOTS website can claim to offer “organic” mattresses. Despite that, many companies use the word, or claim one or more component is made of organic content. If they don’t provide a dated certificate, as well as a GOTS or GOLLS logo, you

should not consider their claim to be accurate.



GOTS—Global Organic Textile Standard is a global standard for textiles made from organic fibers such as cotton, wool, and kapok that covers the entire processing chain. Products

must contain a minimum of 70% organically grown natural fibers to be certified. It establishes restrictions on chemical inputs with an extensive Restricted Substances List, and prohibits phthalates, PFAS, heavy metals, flame retardants, and more. To make a claim that a product is “organic,” at least 95% of the fiber content must be of certified organic origin. Certified companies are listed on their website.

Learn more: www.global-standard.org

Crib mattresses made by Lifekind®, My Green Mattress, Naturepedic®, Obasan, OMI®, Savvy Rest, and White Lotus Home are verifiably GOTS certified. Brentwood and My Green Mattress® have each received GOTS certification for mattresses, but not for their crib mattresses.



GOLS—Global Organic Latex Standard is a global standard for raw latex, latex foam and products made

with latex foam, administered by Control Union Certifications. It requires a minimum of 95% certified organic raw material, and sets limits on harmful chemical additives, processing agents, and fillers, as well as setting emissions standards, following the GOTS and Eco-Label Institute standard for materials other than latex used to make the final product. GOLS does not list certified companies.

Learn more: certifications.controlunion.com/en/certification-programs/certification-programs/gols-global-organic-latex-standard

Lifekind®, Obasan, OMI®, and Soaring Heart provide GOLS certification certificates on their websites. My Green Mattress® component is GOLS certified.



The **USDA Organic** certification is set through federal regulation and applies to agricultural goods, including cotton. Independent labs verify the goods are free of many fertilizers and pesticides, but don't address processing into textiles. Companies may claim USDA organic cotton, but the true test for products like mattresses is the GOTS certification.

Learn more: www.usda.gov/topics/organic

OTHER INDEPENDENT CERTIFICATIONS

When certifications are developed by people independent of the industries making the product, they are considered “Third-party” certifications. All organic standards on the previous page fit this description. The following are additional standards that remain independent of the industries they certify.



OEKO-TEX® is comprised of 18 independent research and test institutes in Europe and Japan. It offers certifications to textile and leather companies to have their products tested for harmful substances by independent institutes, and to make their production conditions and their supply chains more sustainable.

The OEKO-TEX® Association has developed six certifications: Standard 100 is the one claimed by crib mattress makers we surveyed; Sustainable Textile & Leather Production—STeP; MADE IN GREEN, ECO PASSPORT, DETOX TO ZERO, LEATHER STANDARD.

Standard 100 sets limits on a wide range of harmful chemicals. Many limits are based on government regulations, though some go further, including forbidding flame retardants and setting limits on PFAS chemicals in baby

products, including crib mattresses.

Learn more: www.oeko-tex.com

We were unable to verify product-level certification for any of the companies claiming OEKO-TEX® certification (Babyletto, KidiComfort™, L.A. Baby, My Green Mattress®, Nook Sleep).

UL runs numerous certification programs. Of those, crib mattress makers claim UL GreenGuard, UL GreenGuard Gold, and UL Formaldehyde Free.



UL GreenGuard sets emissions limits—not content limits—on 360 volatile organic compounds (VOCs). This means placing the entire product in a testing chamber and testing the air.



UL GreenGuard Gold has more stringent emissions levels, setting them at 1/100th of the concentration for Threshold Limit Values for VOCs as established by American Conference of Governmental Industrial

Hygienists (ACGIH®) and will not certify if emissions are above half of California's Chronic Reference Exposures Levels. UL GreenGuard used to include phthalates in its more stringent testing protocol, but no longer does so.



Formaldehyde Free certification can be earned in addition to the UL GreenGuard Gold certification (but not separately) through a process that audits raw materials for formaldehyde or chemicals that can

turn into formaldehyde and testing the final product for formaldehyde emissions.

Learn more: greenguard.org

To find UL certified products, visit: spot.ul.com/main-app/products/catalog/

Mattresses by Babyletto, Bundle of Dreams®, Colgate Mattress®, Delta, Kolcraft®, Lifekind®, Lullaby Earth™, Moonlight Slumber™, My Green Mattress®, Naturepedic®, Newton Baby®,

OMI®, Safety 1st, Sealy™, Serta™, Simmons Kids®, and Stearns & Foster™ are verifiably UL GREENGUARD and /or ULGREENGUARD Gold certified. Lullaby Earth™ and Naturepedic® have verified UL Formaldehyde Free certifications.



CertiPUR-US® is a certification created by the Polyurethane Foam Association and is now run by the Alliance for Flexible Polyurethane Foam. That alliance no longer has an independent website, and no longer discloses its leadership. The certification tests for content and emissions for banned ozone-depleters and chlorofluorocarbons, flame retardants restricted in the US, heavy metals and phthalates prohibited by federal law, and limits VOCs to 0.5 parts per million. In essence, this certification does not go beyond legal limitations.

Learn more: certipur.us

The following crib mattress companies are listed as certified on the CertiPUR-US®



Juvenile Products Manufacturers Association (JPMA) is a trade association that certifies projects to various ASTM standards. Specification 2399 covers crib mattresses. The scope is the design requirements for full-sized mattresses. ASTM states, “this standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.”

Learn more: www.jpma.org
www.astm.org/Standards/F2933.htm

JPMA lists Colgate Mattress® as certified for crib mattresses.



Additional Considerations

In the original Mattress Matters report in 2011, we highlighted products that contained potential allergens. Today, there is a large focus on “breathability.” We are not including these factors in our rankings, but parents may want to consider them when making a mattress purchase.

ALLERGENS

Latex. Parents may want to avoid latex in a crib mattress because the proteins in natural latex can trigger rare but serious allergic reactions when inhaled. Those born with spina bifida are more prone to this allergy. How latex in mattresses is covered may affect its ability to become airborne and pose a threat.

Synthetic latex is made from styrene and butadiene, and while it does not contain the proteins that cause allergies, both primary ingredients are volatile organic compounds (VOCs). Styrene may cause cancer, affect liver function, irritate the eyes and impair motor skills.⁵⁰ Butadiene is known to cause cancer, harm the nervous system, and irritate eyes and skin.⁵¹

Wool. Wool is naturally flame resistant and water repellant. However, contact with it can irritate skin (easily addressed if it is an interior component, or if a sheet is used.) In some very rare cases, people might have an allergy to lanolin, the waxy substance on the wool fibers.

Coir. The fibers from coconut husks are bound with latex into fibrous mats. Whether or not latex is disclosed, we are unaware of any coir not bound with latex.

BREATHABILITY AND SIDS

As research into Sudden Infant Death Syndrome (SIDS) identified carbon dioxide near sleeping babies’ faces as a contributing factor, many mat-

tress companies have touted breathability as a major benefit of some of their designs.

What may offer some peace of mind to parents, regardless of the mattress they choose, is that having a fan in the room in which baby sleeps can dramatically reduce the likelihood of SIDS.⁵² The American Academy of Pediatrics recommends the following until babies reach one year old:⁵³

- Putting your baby on their back to sleep.
- Keeping the crib (and other sleep spaces) free of loose blankets, stuffed animals, bumpers, or other soft cloth items.
- Choose a firm sleep surface.
- Keeping the room from getting overheated.
- Skip sleep positioners, specialized sleep surfaces (such as those that are highly “breathable”) or special mattresses—none have been found by the American Academy of Pediatrics to reduce risk of SIDS.

When companies offer “breathable” mattresses, ask yourself what that will do for your child’s sleep space. Is the cover waterproof? If not, “breathable” may mean that if your baby throws up or has a diaper leak, those fluids could seep into the mattress, promote bacterial growth, and re-enter their breathing space as they sleep.

Also, all mattresses must be breathable to some extent—if they were completely sealed, an enthusiastic one-year old jumping could pop the mattress like a balloon. That’s why vents are added to sides.

For mattresses designed to increase airflow, the materials inside the mattress matter even more—repeated compression can release small particles and send out off-gassing chemicals and dust containing chemicals of concern.

Recommendations

PARENTS

As we discovered, it can be a challenge to know which health and environmental claims are valid and which are not. Use this report as a guide if you're in the market for a new mattress, and share it with family and friends.

If you already have a crib mattress, call the manufacturer and ask about the materials. Express your demand that they be fully transparent, and that they ensure products they offer for sale are free of harmful chemicals.

Key things to look for on labels and websites:

- 1) **Check for specific information** about materials for each part of the mattress, including the material or chemical that imparts advertised qualities like antimicrobial, or waterproof.
- 2) **Choose strong certifications:** MADE SAFE®, GOTS, GOLS. Whenever possible, verify on the certifying organization's database. For GOLS, look for a certificate on the maker's website.
- 3) **Avoid chemicals of concern:** polyvinyl chloride (PVC or vinyl), modacrylic, PFAS, and anti-microbials of any kind. Prefer products without polyurethane foam.

CHILD CARE PROVIDERS

While this report does not assess crib mattresses made for commercial settings like hotels and child care settings, the materials described here are likely used in those products.

- Avoid PVC/vinyl to the greatest extent possible.
- Ask manufacturers about how the mattresses meet flammability standards, follow up if told "with a flame barrier" to find out what the barrier is made of. Choose those made without modacrylic or added flame retardants.
- Choose the most inherently safe materials you

can within your budget, using the content of this report to guide you.

- Tell your vendors that you seek mattresses without harmful chemicals.
- Share this report with families.

MANUFACTURERS

Families count on crib mattress makers to provide the item that babies spend the most time using. Changes are needed to ensure all babies have safe, healthy sleeping spaces. Companies should:

- 1) **Make all of your mattresses free of harmful chemicals.** This report highlights the materials already in use in mattresses at every price point. Safer mattresses for everyone is entirely practicable. Work with suppliers and up the supply chain to ensure the materials you use are what you expect, and are safe materials.
- 2) **Use strong third-party certifications** to confirm claims about materials, and provide links to certification databases, or PDFs of certification verification on websites and on packaging.
- 3) Stop confusing consumers with misleading terms like "nontoxic" and "ecofriendly" or claims like "organic" without verifiable certification.
- 4) **Make product descriptions accurate and complete,** including additives, coatings, and all components of any flame barriers.
- 5) **Initiate a policy** to phase out chemicals of concern with a firm timeline, and publicize it.

The largest manufacturers—Colgate, Delta, and Kolcraft® should use their position to lead the way to full product offerings free of harmful chemicals.

All manufacturers should fill the marketplace with better products that are easy to find and affordable for all families.



RETAILERS

Recent years have shown the real power retailers have to drive market shifts toward safer chemicals.

To ensure all crib mattresses are free of harmful chemicals, retailers should:

- **Establish or expand a Restricted Substances List to prohibit the use of chemicals of concern** discussed in this report. Include them in Manufacturing Restricted Substances Lists as well—there is evidence some PFAS chemicals appear in crib mattresses due to contamination during production.
- **Verify manufacturer disclosures** about materials through third-party laboratory analysis.
- **Verify certification claims** - and stop selling products with unverified claims.
- **Display full product information**, including all chemicals and materials in the product, on retailer product webpages, and require it on printed external marketing materials attached to each product.

GOVERNMENT

There are few real obstacles to making healthier mattresses—as shown by our findings. However, government policies are needed to ensure the full range of offerings is free from harmful chemicals. Policymakers at the state and federal level should:

- **Ban PFAS chemicals**, especially in children's products. They have no place in the nursery.
- **Ban chemicals used as flame retardants** in children's products, including those that can also be used by adults, such as twin mattresses. California and Maryland have already taken action on much of this, and other states should do so. This report demonstrates that crib mattresses can be made without these chemicals.
- **Help parents find safer products by holding companies that misrepresent product qualities financially accountable.** Use and enact laws and regulations to ensure accuracy in advertising and green claims (such as the Federal Trade Commission's "Green Guide").

Lessons for the Broader Market

While this report covers crib mattresses, there are important lessons to be drawn for the broader market of products, whether intended for children or not.

First, it is clear that companies are responding to the growing demand for safer chemicals and healthier products. And like many other market sectors, there are three general responses:

- 1) **Worse:** making small changes (such as adding a single layer of organic cotton, or adding a small portion of plant-based oil to polyurethane foam) and hyping them as being the best possible option.
- 2) **Better:** Choosing safer materials (such as polyester over polyurethane, polyethylene coated cotton over vinyl) with clear explanations for such choices. These provide the marketplace with cost-effective options when materials like organic cotton are currently genuinely cost-prohibitive.
- 3) **Best:** selection of inherently benign materials (such as organic cotton) and provision of clear information to help potential customers understand why their product is inherently healthier. Use of rigorous independent “third-party” certifications that can be verified by anyone who is interested.

We see examples of each of these responses in our research of crib mattresses and the broader marketplace.

Companies need to be held

accountable for accuracy, transparency, and choosing inherently safer materials that protect people and the planet across the entire “life” of a product, including a meaningfully better solution to disposal than dumping items in landfills or burning them in incinerators.

The demand for safer products will continue to grow, and will persist through shrinking and growing markets, as it has done for decades. Further, such changes are needed to help safeguard people and the planet from harmful chemicals.

That makes various accountability tools described in our recommendations—from individuals, manufacturers, retailers and government bodies—critically important, both to provide safer products and to make it easy for people to distinguish them from those made with harmful chemicals and materials.



References

1. Philip J. Landrigan and Lynn R. Goldman. Children's Vulnerability To Toxic Chemicals: A Challenge and Opportunity to Strengthen Health and Environmental Policy. *Health Affairs* Vol 30, No. 5: Challenges for Health 2011 <https://www.healthaffairs.org/doi/10.1377/hlthaff.2011.0151>
2. Agency for Toxic Substances and Disease Registry. Per- and Polyfluoroalkyl Substances (PFAS) and Your Health. 2020. <https://www.atsdr.cdc.gov/pfas/health-effects.html>
3. Kaiser Permanente. Banning use of antimicrobial agents for infection control 2015. <https://about.kaiserpermanente.org/total-health/health-topics/kaiser-permanente-rejects-antimicrobials-for-infection-control>
4. National Institute of Environmental Health Sciences. Flame Retardants. 2016. https://www.niehs.nih.gov/health/materials/flame_retardants_508.pdf
5. California Environmental Protection Agency. Antimony Trioxide. <https://www.p65warnings.ca.gov/fact-sheets/antimony-trioxide>
6. ToxTown, National Institutes of Health. Polyvinyl Chloride. 2017. <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/polyvinyl-chloride-pvc>
7. A. James Clark School of Engineering Center for Advanced Lifecycle Engineering, University of Maryland. Phthalate Risks and Alternatives. 2018. <https://calce.umd.edu/phthalate-risks-and-alternatives>
8. Fan-Long Jin, et al. Recent Trends of Foaming in Polymer Processing: A Review. *Polymers* (Basel). 2019. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6631771/>
9. Brandon E Boor, et. al. Infant Exposure to Emissions of Volatile Organic Compounds from Crib Mattresses. *Environmental Science & Technology*. 2014. <https://pubs.acs.org/doi/abs/10.1021/es405625q>
10. Baby Center: https://www.babycenter.com/0_baby-sleep-basics-birth-to-3-months_7654.bc
11. Learn more at ToxTown; <https://toxtown.nlm.nih.gov/>
12. Agency for Toxic Substances and Disease Registry. An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances and Interim Guidance for Clinicians Responding to Patient Exposure Concerns. (2018).
13. Liew, Zeyan et al. Developmental Exposures to Perfluoroalkyl Substances (PFASs): An Update of Associated Health Outcomes. *Current Environmental Health Reports* (2018) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6348874/>
14. Commission for Environmental Cooperation. Furthering the Understanding of the Migration of Chemicals from Consumer Products - A Study of Per- and Polyfluoroalkyl Substances (PFASs) in Clothing, Apparel, and Children's Items. 2017. <http://www3.cec.org/islandora/en/item/11777-furthering-understanding-migration-chemicals-from-consumer-products>
15. Kaiser Permanente. Banning use of antimicrobial agents for infection control 2015. <https://about.kaiserpermanente.org/total-health/health-topics/kaiser-permanente-rejects-antimicrobials-for-infection-control>
16. Justia Trademarks. STAPHGARD—Trademark Details. <https://trademarks.justia.com/774/62/staphgard-77462069.html>
17. Synthetic Labs. Staphguard Safety Data Sheet. 2017. <https://www.syntecpro.com/wp-content/uploads/2016/02/2772.pdf>
18. Vanessa E. Melin, et al., Quaternary Ammonium Disinfectants Cause Subfertility in Mice by Targeting Both Male and Female Reproductive Processes. *Reproductive Toxicology*. 2016. <https://pubmed.ncbi.nlm.nih.gov/26582257/>
19. Perkins+Will for the National Institutes of Health. Healthy Environments: A compilation of Substances Linked to Asthma. 2011. <https://nems.nih.gov/Sustainability/Documents/NIH%20Asthma%20Report.pdf>
20. Ahamed, Masquood et al. Silver Nanoparticle Applications and Human Health. *Clinica Chimica Acta*. 2010.

- <https://www.sciencedirect.com/science/article/abs/pii/S0009898110005139?via%3Dihub>
21. A. James Clark School of Engineering Center for Advanced Lifecycle Engineering, University of Maryland. Phthalate Risks and Alternatives. 2018. <https://calce.umd.edu/phthalate-risks-and-alternatives>
 22. US Consumer Product Safety Commission. Phthalates Business Guidance & Small Entity Compliance Code. 2019. <https://www.cpsc.gov/Business-Manufacturing/Business-Education/Business-Guidance/Phthalates-Information>
 23. Kambia, N. K., et al. In vitro and in silico hormonal activity studies of di-(2-ethylhexyl)terephthalate, a di-(2-ethylhexyl)phthalate substitute used in medical devices, and its metabolites. *Journal of Applied Toxicology*. 2019.
 24. Kambia, N. K., et al. Docking study: PPARs interaction with the selected alternative plasticizers to di(2-ethylhexyl) phthalate. *J Enzyme Inhib Med Chem* 31, 448–455 (2016).
 25. Sheikh, I. A., et al. Endocrine disruption: In silico perspectives of interactions of di-(2-ethylhexyl) phthalate and its five major metabolites with progesterone receptor. *BMC Struct Biol* 16, (2016).
 26. Bhat, Virunya S., et al. Derivation of an Oral Reference Dose (RfD) for the Nonphthalate Alternative Plasticizer 1,2-Cyclohexane Dicarboxylic Acid, Diisononyl Ester (DINCH), *Journal of Toxicology and Environmental Health, Part B*, 17:2, 63–94, (2014). <https://pubmed.ncbi.nlm.nih.gov/24627975/>
 27. National Institute of Environmental Health Sciences. Flame Retardants. 2016. https://www.niehs.nih.gov/health/materials/flame_retardants_508.pdf
 28. Same as above.
 29. Kim, U.-J. & Kannan, K. Occurrence and Distribution of Organophosphate Flame Retardants/Plasticizers in Surface Waters, Tap Water, and Rainwater: Implications for Human Exposure. *Environmental Science & Technology*. 2018. <https://pubmed.ncbi.nlm.nih.gov/29659254/>
 30. Zhang, Q. et al. Potential Estrogenic Effects of Phosphorus-Containing Flame Retardants. *Environmental Science & Technology*. 2014. <https://pubmed.ncbi.nlm.nih.gov/24844797/>
 31. Isales, G. M., et al. Triphenyl phosphate-induced developmental toxicity in zebrafish: Potential role of the retinoic acid receptor. *Aquatic Toxicology*. 2015. <https://pubmed.ncbi.nlm.nih.gov/25725299/>
 32. Hendriks, H. S. & Westerink, R. H. S. Neurotoxicity and risk assessment of brominated and alternative flame retardants. *Neurotoxicology and Teratology*. 2015. <https://pubmed.ncbi.nlm.nih.gov/26363216/>
 33. National Toxicology Program. Monograph on Antimony Trioxide. Report on Carcinogens. 2018. https://ntp.niehs.nih.gov/ntp/roc/monographs/antimony_final20181019_508.pdf
 34. Pharos Project. Acrylonitrile hazard profile. 2020. <https://pharosproject.net/chemicals/2006129#hazards-panel>
 35. Pharos Project, Polyvinyl Chloride hazard profile. 2020. <https://pharosproject.net/chemicals/2096850#hazards-panel>
 36. Pharos Project. Vinylidene Chloride hazard profile. 2020. <https://pharosproject.net/chemicals/2004387#hazards-panel>
 37. ToxTown, National Institutes of Health. Lead. 2017. <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/lead>
 38. ToxTown, National Institutes of Health. Cadmium. 2017. <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/cadmium>
 39. ToxTown, National Institutes of Health. Volatile Organic Compounds (VOCs). 2017. <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/volatile-organic-compounds-vocs>
 40. ToxTown, National Institutes of Health. Polyvinyl Chloride (PVC). 2017. <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/polyvinyl-chloride-pvc>
 41. Agency for Toxic Substances and Disease Registry. Toxic Substances Portal—Vinyl Chloride. 2006. <https://www.atsdr.cdc.gov/phs/phs.asp?id=280&tid=51>
 42. Ruth Stringer, Paul Johnston. Chlorine and the Environment: An overview of the Chlorine Industry. 2001. <https://books.google.com/books?id=7GB94Vbblm4C&pg=PA99&lpg=PA99&dq=chemicals+released+when+PVC+burns+furan#v=onepage&q>

- =chemicals%20released%20when%20PVC%20burns%20furan&f=false
43. The National Institute for Occupational Safety and Health (NIOSH) Workplace Safety and Health Topics—Isocyanates. 2014. <https://www.cdc.gov/niosh/topics/isocyanates/default.html>
 44. Fan-Long Jin et al. Recent Trends of Foaming in Polymer Processing: A Review. *Polymers (Basel)*. 2019. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6631771/>
 45. Effect of Antimony Catalyst on Solid-State Polycondensation of Poly(Ethylene Terephthalate). *Polymer*. 2002. https://www.researchgate.net/publication/229209250_Effect_of_antimony_catalyst_on_solid-state_polycondensation_of_polyethylene_terephthalate
 46. L.A. Baby Frequently Asked Questions (FAQ) <https://www.lababyco.com/products/item/289>
 47. Fromme, Hermann, et al. Alkylsulfonic acid phenylesters (ASEs, Mesamoll®) in dust samples of German residences and daycare centers (LUPE 3). *International Journal of Hygiene and Environmental Health*. 2017. <https://www.sciencedirect.com/science/article/abs/pii/S143846391630387X>
 48. Agency for Toxic Substances and Disease Registry. (ATSDR) <https://www.atsdr.cdc.gov/ToxProfiles/tp53-c2.pdf>
 49. ATSDR: <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=81>
 50. Kimberly Coleman-Phox et al. Using a Fan During Sleep and the Risk of Sudden Infant Death Syndrome. *Arch Pediatr Adolesc Med*. 2008. <https://pubmed.ncbi.nlm.nih.gov/18838649/>
 51. Rachel Y. Moon, MD, FAAP. How to Keep Your Sleeping Baby Safe: AAP Policy Explained. 2020. American Academy of Pediatrics. <https://www.healthychildren.org/English/ages-stages/baby/sleep/Pages/A-Parents-Guide-to-Safe-Sleep.aspx>

Appendix I: Detailed Methods

SURVEYING MATTRESS WEBSITES

We searched the internet for crib mattress makers, striving to capture the full market of crib mattress brands, and then identified all the mattresses described on their websites, to assess them based on their own presentation of the information. We identified 37 companies and 227 distinct crib mattress models. We then sought to identify the chemicals and materials used in:

- Cover, including coatings on front or back, anti-microbial additives, and binding, including removable covers and permanent ones.
- Fire barriers, including primary materials and any coatings or additives.
- Padding layers.
- Core materials and additives.
- Environmental and health claims.
- Certifications.

After compiling information from company websites in 2019, we sent letters with our findings to each company seeking their response. In 2020, we confirmed our information via product websites.

We then checked certification databases to verify the accuracy of company claims.

SAMPLE COLLECTION

We purchased thirteen crib mattresses and four adult mattresses from major retailers, then separated each into components for testing. Components included covers, layers thereof, fire barrier

wraps, and core parts. Pieces were cut with scissors and shears and immediately placed into clean plastic sample bags. Cutting instruments were cleaned with isopropanol before and after each cut.

A total of 103 components were taken from the crib mattresses.

TESTING METHODS

Mattress components were subject to multiple analytical techniques:

High-definition X-ray fluorescence (HD XRF)

Each of the 164 mattress components were screened for elements of interest by HD XRF using an HD Prime spectrometer by XOS. This technique measures levels of heavy metals as well as elements that indicate flame retardant chemicals.

Fourier Transform Infrared (FTIR) spectroscopy

Nearly all of the components were analyzed by FTIR to determine the polymer type. A subset were also subject to solvent extraction followed by FTIR to test the presence of additives such as plasticizer chemicals.

Gas chromatography with mass spectrometry (GC/MS)

Six of the crib mattresses had PVC (vinyl) covers, all of which we sent to a commercial lab, TUV Rheinland, for detection of plasticizer chemicals. The plasticizers analyzed included ortho-phthalates, DOTP, DINCH, benzoate esters, and adipates.

** Clean and Healthy New York identified and added information about Ikea, Lifekind, and Safety 1st products after brand feedback portion of the data was collected. Safety 1st does not make information available on their own website, but was included in this survey because that brand also makes car seats, a product focus of the Ecology Center.*

Liquid chromatography with mass spectrometry (LC/MS/MS)

Researchers at Indiana University analyzed 29 crib mattress components—cores and fire barrier wraps—using this highly sensitive technique to measure 82 flame retardant and related chemicals, including brominated, phosphorus-based, and melamine compounds.

In addition, seven crib covers were analyzed by LC/MS/MS for 43 individual PFAS compounds, including PFOA and PFOS.

Particle-induced gamma ray excitation (PIGE)

Outer covers, including tops, sides and bottoms if materials differed, were subject to PIGE at the University of Notre Dame to determine total fluorine content. Total fluorine indicates the presence of PFAS chemicals when other sources of fluorine are ruled out.



Appendix II: Sample Letter to Manufacturers

Dear Company Leader,

I am writing on behalf of the Getting Ready for Baby coalition of over 100 organizations, because we are preparing a report on the materials used to construct crib mattresses. Our goal is to help parents-to-be and parents of young children understand what materials they'll be putting in their child's crib when they purchase a particular mattress.

Our organizations routinely get requests for this information, and the internet is rife with blogs from moms trying to identify the safest, least toxic materials, often without full information. In 2011, Clean and Healthy New York and the American Sustainable Business Council released *The Mattress Matters*, which assessed available information about the components that make up crib mattresses. This year, the Getting Ready for Baby campaign is updating that report, combining it with laboratory testing on a subset of available mattresses.

Our report will identify available information and assess each company's transparency with consumers about what goes into the crib mattresses they offer, and provide an evaluation of materials present.

We have the following questions for each product or product line (the largest grouping for which all material components are made of the same things). For your convenience, we have attached an editable spreadsheet with the publicly available information about the materials in the products you offer. Please complete, clarify, or correct this information.

We will be compiling the results of our research and responses we receive from manufacturers over the next month and a half. Please reply to bobbi@cleanhealthyny.org (and include the words "crib mattress" in the subject) no later than XXX.

Please do not hesitate to contact us with any questions about how to fill out the spreadsheet. If all of your products use the same materials, thread, coatings, fabric treatments, etc., please feel free simply to reply in the body of an email address or in a written attachment.

Thank you.

Sincerely,

Roberta Wilding
Director, Getting Ready for Baby campaign
Deputy Director, Clean and Healthy New York

QUESTIONS FOR EACH CRIB MATTRESS PRODUCT LINE:

How many individual products (distinct SKUs) are included in this grouping?

(continued on next page)

Exterior

- What comprises the exterior of the crib mattress(es)? For example, “polyethylene coated cotton” instead of “woven fabric.”
- Is the product waterproof? If so, is the waterproofing material on the top or backing of the mattress surface?
- If your product(s) are waterproof, what chemical or material provides that quality? For example, polyethylene, polyurethane, vinyl, per- or polyfluoroalkyl substance (PFAS) waterproof coating?
- If your product contains vinyl, please describe the plasticizers and stabilizers. If it includes phthalate chemicals not covered by the Consumer Product Safety Improvement Act, please identify them.
- Is the product identified as “antimicrobial”?
- If so, please identify the antimicrobial agent with specificity about the chemical ingredients. For example, “triclosan” instead of “Microban.”
- How do you bind your exterior? If with thread, please specify the material. If with glue, please do the same.

Meeting flammability standards

- How does your product achieve flammability standards? For example, chemicals added to fabric, chemicals added to foam, inherently flame retardant fabric barrier.
- If chemicals are added to specific materials, please identify both the treated component and the specific chemicals.
- If barrier or exterior materials are “inherently flame retardant”, please identify the material that has those qualities (such as wool, Kevlar), and if that material includes chemically bound (“polymeric”) flame retardants, please identify them.
- If “modacrylic,” does it contain vinylidene chloride or antimony?

Interior

- If there are layers of padding, of what kind of material is each comprised?
- If layers are adhered together, what chemicals are in the adhesive? Are those adhesives certified formaldehyde-free?
- Of what is the core of the mattress made?
- If latex, is it natural or synthetic?
- If foam, please specify the material.
- If it is plastic, please specify the material.
- If the mattress contains any other component in its interior that doesn’t fall into the questions above, please describe their function and chemical content.

Certifications and health claims

- Are any of the materials present in the mattress “organic”? If so, please provide certification information.
- Does the information in the mattress description identify it as “non-toxic”? If so, please provide the basis for that claim.
- Do you identify your mattress as free of chemical flame retardants? How do you verify and document that claim?
- If the marketing of the mattress includes claims like “breathable” or “healthy” upon what evidence do you base those claims?

CLEAN & HEALTHY NEW YORK

Clean and Healthy New York is a state-based environmental health advocacy organization that works at local, state, and national levels to promote safer chemicals, a sustainable economy, and a healthier world.

chny.org



The Ecology Center is a Michigan-based nonprofit environmental organization that works at the local, state, and national levels for clean production, healthy communities, environmental justice, and a sustainable future.

ecocenter.org



The Getting Ready for Baby campaign is a national collaboration of over 100 organizations working to ensure all products made for babies are free of harmful chemicals. Simply put: every baby product should be a healthy product.

gettingready4baby.org