

# Antimony in baby products

HEAVY METAL INDEX · SYNTHESIS REPORT

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## Abstract

Screens have measured antimony in baby-wipe components, an element the eight-metal food panel does not cover. Limits for water, toy migration, and cosmetics exist, but each is written on a basis that does not transfer to a wipe.

## 1 | Overview

Antimony is an element that a children's-product screen can find in polyester-containing articles while a food panel built on lead, cadmium, arsenic, mercury, nickel, aluminium, chromium, and tin reports nothing about it. That asymmetry is the subject of this synthesis. For each class of infant product it asks what has been measured, on what basis, which limit could apply, and what is still unknown. It sets no certification number and names no brands. The toxicology, the IARC classification, and the split between reference values are treated on the companion metal page, antimony.

The evidence is uneven, and the unevenness is itself the finding. Screening surveys and a small number of papers have measured antimony in wipe components, polyester textiles, and PET plastics. Limits exist for drinking water, for migration from plastic into food, for migration from toys, and as cosmetic impurity guidance. None of those instruments measures what a wipe delivers to infant skin, and no study converts a wipe concentration into an absorbed dose. What can be said with confidence is therefore narrower than the number of antimony figures in circulation suggests: antimony is present in some infant articles, a food-style panel will not detect it, and the dose question is open.

The review draws on the IARC Volume 131 antimony chapter, NTP Technical Report 590, the 2018 Report on Carcinogens monograph, the OECD SIDS profile for diantimony trioxide, the 2016 OEHHA public health goal, the full text of Choi 2016, Washington Ecology 15-03-039, the Greenpeace Research Laboratories technical report 06/2013, and the PET, toy, and microbial papers cited below. The 2026 China monitoring page contributes its detection count and the total-antimony row of its annex table, in µg/L. Every figure is reported as its source prints it. Where a source prints no value, none is supplied.

## 2 | Why each number has to be read with its basis

A part-per-million total in an acid-digested component, a microgram-per-litre result in drinking water, a specific migration limit into food, and a soluble migration limit for toy material are four different quantities, and most confusion about antimony in infant products comes from reading them as one. Washington Ecology's wipe results are total elemental antimony in components that were first prioritized by X-ray fluorescence and then confirmed by ICP-MS<sup>1</sup>. EN 71-3 limits are soluble antimony migrating into 0.07 M hydrochloric acid, in milligrams per kilogram of toy material<sup>2</sup>. EU Regulation 10/2011 limits antimony migrating from plastic into food at 0.04 mg/kg<sup>3</sup>. None of these instruments is a dermal dose.

The dermal figures that do exist are thin. The ATSDR profile prints no percent absorption for intact infant skin<sup>4</sup>. The OECD SIDS profile reports that an in vitro human-skin study showed 0.26 percent absorption of diantimony trioxide, and treats that absorption as negligible<sup>34</sup>. OEHHA 2016 identifies the same unpublished study (Roper and Stupart 2006) and prints two results from six skin samples after 24 hours: 0.26 percent at 100 µg/cm<sup>2</sup> and 0.14 percent at 300 µg/cm<sup>2</sup><sup>35</sup>. The primary report was not examined for this review, and neither figure is a wipe dose.

## 3 | Baby wipes: what the screens measured

Publication 14-04-014, revised June 2021, reports antimony at 70.6, 61.3, and 40.6 ppm in three baby-wipe components, and at 95.8 ppm in moist baby-wipes packaging<sup>1</sup>. The design governs how those figures can be used. It is an upper-tail screen of products bought in Washington, not a probability sample of the wipes on the market, and across it antimony was detected in 57 percent of 150 children's-product components. The report's frame of reference is the Washington Children's Safe Products Act threshold of 100 ppm for chemicals of high concern to children. That threshold is a manufacturer reporting trigger, not a health-based maximum.

The pathway that makes antimony plausible in a polyester wipe is catalyst residue from the manufacture of polyethylene terephthalate or polyester, and IARC's Volume 131 announcement lists plastics among antimony's uses<sup>5</sup>. The explanation is an inference from that use pattern, not a result in the report. Stone's method does not speciate Sb(III) and Sb(V), and it does not assay the polymer for residual catalyst.

Choi, Song, and Kim 2016 digested approximately 0.2 g of nonwoven in 7 mL of 70 percent nitric acid and 1 mL of 50 percent hydrofluoric acid, then transferred and diluted the digest with 25 mL of ASTM type 1 water<sup>26</sup>. The authors print the mass as approximate. They do not say the solution was made up to 25 mL, and they do not state a final volume after the 8 mL of acid. Table 5 reports antimony in 12 of 24 wet-wipe nonwovens, from 187.86 ± 5.24 to 19,558.35 ± 3,537.3 µg/L. The highest of those results is the infant sheet labeled rayon alone. Several sheets labeled rayon plus polyester or rayon plus PET had no detected antimony. The authors attribute high antimony to an antimony trioxide or antimony glycolate catalyst. That attribution is their inference. It is not a rule for these sheets, because the highest result is the rayon-labeled sheet.

They do not convert the digest concentrations to a sheet concentration. If the final volume is treated as 25 mL and the mass as 0.200 g, mg/kg is approximately (µg/L × 0.025 L / 0.0002 kg) / 1,000, or µg/L × 0.125, and the two ends are about 23.48 and 2,444.79 mg/kg. The division by 1,000 is needed because the quotient is in micrograms per kilogram. If the 8 mL of acid remains and the 25 mL of water is added to it, the volume is 33 mL, the factor is 0.165, and the high end is about 3,227.13 mg/kg. Neither figure is printed. Both depend on a volume the authors did not state. The source page keeps both readings and does not use either as the paper's result.

Mask packs are a separate table. The source page records one pack at 8,895.28 ± 42.86 µg/L in the nonwoven and 38.95 ± 1.86 µg/L in the liquid, and states that the authors did not publish that split for the wet wipes. Other

mask-pack antimony figures are not carried here, because that source page does not adopt them. Borca 2025, discussed below, found organic antimony rather than the trioxide in PET bottles<sup>27</sup>, so the catalyst reading and the oxide reading are kept apart.

A 2025 master's thesis from Istanbul reports solution antimony of 695.40 ppb in one product, which the English abstract rounds to 695.4 ppb, and fiber antimony printed as 565.46 ppb and 537.86 ppb, with a further sentence and section 4.1 printing 476.69 ppb for fiber<sup>48</sup>. All three fiber figures are in the thesis, and 476.69 is lower than the other two. Packaging antimony is printed at 0.03 and 0.04 ppb, at or below the quantification limit of 0.10 ppb. The antimony results of several hundred ppb sit above the stated calibration top of 50 ppb. The methods digested an approximate 0.2 g and then added 10 mL of water, and they do not print a made-up final volume, so no sheet concentration is calculated. Brand names are not repeated.

A monitoring page dated 2 April 2026 from the China Association for Quality Promotion of Consumer Products Safety reports total antimony detected in 20 of 21 baby wet wipes bought online, and not detected in one<sup>28</sup>. The sample-by-sample annex is an image. Preferred reads of total antimony, taken as micrograms per liter, are numeric in 20 of 21 columns. The stable low read is 15.02 µg/L and the stable high preferred read is 450.45 µg/L. The source page's preferred read for one wrapped cell is 383.7 µg/L, with the last digit low confidence. A second full-cell pass of the same image also produced 490.40 µg/L where the preferred read is 450.45, and 399.43 µg/L where the preferred read is 355.43. Several other wrapped cells have a less certain second digit. The preparation that produced the per-liter figure is not described, so the unit is not a milligram-per-kilogram sheet concentration. The narrative names products, and this synthesis does not repeat them.

#### 4 | Which limits could apply to a wipe, and why none yet decides one

Several instruments are candidates, and each fails to fit for its own reason. Health Canada's cosmetic impurity guidance is 5 ppm antimony in a finished cosmetic<sup>6</sup>, but it is guidance rather than regulation, and the guidance text indexed here does not name wipes. Germany's 2017 orientation value is 0.5 mg/kg for cosmetic products in general<sup>7</sup>. Korea's cosmetic trace allowance is 10 µg/g<sup>8</sup>. EU Regulation 1223/2009 prohibits antimony and its compounds as cosmetic ingredients (Annex II, entry 40) and, in Article 17, allows technically unavoidable traces without setting a ppm<sup>9</sup>.

Whether a disposable wipe is legally a cosmetic at all is a classification question this synthesis does not answer. Drinking-water maximums and the EU plastics migration limit are the wrong basis for a wipe-sheet content result. For those reasons, no limit in the table on antimony is applied here as a pass-fail value for wipes.

A concentration in the sheet is also not a dose. A ppm in the sheet is not a microgram on the skin, and a microgram on the skin is not a microgram absorbed. Without a migration result into lotion or sweat, an infant dose cannot be calculated from 40.6 to 70.6 ppm, or from the approximate Choi sheet figures. The 0.26 percent in vitro figure is OECD's summary of an unpublished study of diantimony trioxide on adult skin samples, not a measurement of wipe residue<sup>34</sup>.

The toxicology that would receive a dose, if one were ever calculated, is on the metal page: poor gastrointestinal absorption for non-tartrate forms (ICRP reference values of 1 percent for forms other than tartrate), and a carcinogenicity classification that applies to trivalent antimony as a class<sup>45</sup>.

#### 5 | Diapers: a thorough panel that leaves antimony out

Nyamukamba and colleagues 2023 extracted 20 disposable diapers purchased in Cape Town in artificial sweat and artificial urine, and measured lead, copper, arsenic, zinc, cobalt, nickel, chromium, cadmium, manganese, and selenium<sup>10</sup>. Antimony was not in the panel. Nickel exceeded the 0.1 mg/kg Oeko-Tex value stated by the authors in one sweat extract (0.197 mg/kg) and one urine extract (about 0.224 mg/kg).

The paper disagrees with itself on lead: its prose states a sweat lead range of 0.002 to 0.019 mg/kg, while Table 4 of the same HTML lists a lead maximum of 0.094 mg/kg, and this synthesis adopts no lead range from that conflict. For antimony the lesson is a negative one. A diaper study can be thorough for several metals and still say nothing about antimony.

No diaper study examined here reports total or extractable antimony, so the diaper occurrence cell is a data gap. The Government limits section transcribes a government migration limit and a voluntary final-product criterion that bear on diapers, but neither is a measurement of antimony in a diaper. No US federal limit exists for antimony in diapers<sup>6459</sup>.

## 6 | PET bottles, feeding containers, and the water used for formula

Ungureanu and colleagues 2022 measured antimony in 50 Romanian bottled waters, from below 0.07 µg/L to a printed maximum of  $0.64 \pm 6.85$  µg/L, with a detection limit of 0.07 µg/L<sup>11</sup>. The uncertainty printed on the maximum is larger than the maximum itself. The result belongs to that market. It also does not show that the antimony migrated from PET, because the study did not pair bottle-resin concentrations with water concentrations.

Borca, Huthwelker, and Filella 2025 came at the question from the plastic. They measured six PET bottles at 351, 331, 361, 322, 370, and 370 mg/kg by portable X-ray fluorescence, and antimony L3-edge spectroscopy identified organically bound antimony, consistent with antimony glycolate or acetate, while excluding a significant amount of antimony trioxide in those bottles<sup>27</sup>. The methods text says five bottles and the table prints six; this synthesis follows the table. The samples are not identified as baby bottles, and no migration into the water those bottles held was measured.

The migration studies measure the water or the beverage instead, and none of them uses baby bottles either. Carneado and colleagues 2015 found no migration into mineral water at 4 °C and 20 °C, an increase at 40 °C that stayed under the EU limit of 5.0 µg/L, and, at 60 °C after 30 days, migration that exceeded that limit, with both Sb(V) and Sb(III) detected<sup>40</sup>. Allafi 2020 reports 8.530 ppb after 24 hours at 50 °C and 16.8 ppb after 7 days, against no significant change after three months at 25 °C<sup>41</sup>.

Molaei Aghaee and colleagues 2014 report results still below 6 ppb at room temperature, outdoors, and at 40 °C, and above 6 ppb at 65 °C and 80 °C with longer storage<sup>42</sup>. Mehdar 2025 reports 0.02 to 2.14 µg/L over 200 days, with the 2.14 µg/L result at 60 °C exceeding a Japanese limit of 2.00 µg/L that the paper cites, while the abstract also prints 0.844 µg/L as a concentration in the PET itself<sup>43</sup>.

The common thread in those studies is heat and storage time, which is also how Wang and colleagues 2026 summarize the food-contact literature: ordinary storage often stays under 2.5 µg/L, and acid, heat, and time can push results above 5 µg/L<sup>44</sup>. Their parenthetical equating of 20 ppb with 0.02 mg/kg, and of 40 ppb with 0.04 mg/kg, mixes a water concentration with a food migration limit. This synthesis does not adopt that equivalence.

Further measurements of commercial PET bottles, and of the water or drink in them, are in this corpus. None of them uses a baby bottle.

Chapa-Martínez and colleagues 2016 measured twelve colorless PET bottled waters bought in Monterrey. Antimony in the water as purchased was 0.28 to 2.30 µg/L, with a mean of 1.05 µg/L. The bottle plastic was 73.0 to 111.3 mg/kg, with a mean of 87.6 ± 3.9 mg/kg. Release into ultrapure water, which is not the water as purchased, was 1.1 to 18.5 µg/L at 75 °C, pH 7, and 5 days<sup>70</sup>.

Keresztes and colleagues 2009 measured Hungarian still and sparkling mineral water sold in PET. Antimony in the package was 210 to 290 mg/kg. Still water stored less than one year averaged 0.26 ± 0.16 ng/mL (n = 37). Sparkling water averaged 0.40 ± 0.22 ng/mL (n = 29). Those means are printed in ng/mL. The source page also records a three-year ceiling printed once as 1 µg/L and once as 1 ng/mL, and both printings are kept<sup>71</sup>.

Shotyk, Krachler, and Chen 2006 report water concentrations in ng/L. Twelve Canadian natural waters in PET had an abstract mean of 156 ± 86 ng/L and a body range of 112 to 375 ng/L (n = 21). Across 35 European PET brands from 11 countries the median was 343 ng/L. Neutron activation found 397 mg/kg antimony in one PET water bottle and 351 mg/kg in one PET cola bottle. The detection limit was 0.03 ng/L. Letter codes replace trade names<sup>72</sup>.

Westerhoff and colleagues 2008 measured nine PET bottled waters bought in Arizona. As purchased, antimony was 0.095 to 0.521 ppb. The mean was 0.195 ± 0.116 ppb at the start of the study and 0.226 ± 0.160 ppb after three months at 22 °C. The unit is ppb as printed. Digestion of one bottle's plastic found 213 ± 35 mg/kg. The paper states that heating that bottle to 80 °C raised antimony above the 6 ppb USEPA maximum contaminant level, to 14.4 ppb after seven days. Retail names are omitted<sup>73</sup>.

Tukur 2012 reports Table 2 medians of 260 mg/kg for Nigerian PET (n = 14) and 251 mg/kg for British PET (n = 18). In 47 freshly purchased British bottled waters and soft drinks the printed range is 0.033 to 6.61, and one sample was above the EU drinking-water value of 5 µg/L. The PDF text layer renders that water unit as mg/L. The page image prints µg/L, and this synthesis follows the image, as the source page does<sup>74</sup>.

Shotyk and Krachler 2007 remeasured bottled waters after about six months at room temperature. Antimony increased on average 19 percent in the Canadian brands and 90 percent in 48 European brands. One French mineral water in PET rose from 725 ng/L to 1510 ng/L. The same water bought in Hong Kong contained 1990 ng/L. The source page prints 1.7 ( 0.4 ng/L (n = 6) for pristine groundwater and 26.6 ( 2.3 ng/L (n = 3) after six months in Canadian PET. The open parenthesis stands in for a plus-minus sign that the text extract did not preserve. A range and a median for 69 additional brands are named on the source page and are not among the copied key numbers, so this synthesis does not supply them<sup>75</sup>.

Xu and colleagues 2021 incubated 50 PET-bottled beverages, a set that does not include plain water, at 60 °C for 7 days. Antimony after incubation was 1.10 to 10.9 times the concentration before incubation. Twenty-one beverages then exceeded the Japanese drinking-water standard of 2 µg/L that the authors cite, up to 4.08 ± 0.11 µg/L. Pre-incubation concentrations are not restated on the source page, and the plastic was not analysed. The result is a warm incubation of beverages<sup>76</sup>.

The EFSA AFC opinion of 7 January 2004 evaluates antimony trioxide, REF 35760, as an additive or initiator in PET, at a maximum of 0.035 percent as antimony. The restriction the Panel applies is 0.04 mg/kg of food as antimony. The petitioner's result, as the opinion reports it, used PET containing 350 mg Sb/kg and found the highest migration in 3 percent acetic acid: 31.8 µg of antimony per kg of food simulant. The opinion cites a WHO tolerable daily intake of 0.006 mg Sb/kg body weight per day and describes the 0.04 mg/kg restriction as 10 percent of that intake allocated to food-contact materials. A 1999 SCF classification quoted as background, 0.01 mg/kg with a specific migration limit of 0.02 mg/kg, is the previous evaluation. The opinion is a dossier review, not a survey of bottles on the market<sup>77</sup>.

Where the water used to prepare formula is itself the regulated commodity, the applicable values are the EPA maximum contaminant level of 0.006 mg/L (6 µg/L)<sup>12</sup>, the FDA bottled-water allowable level of 0.006 mg/L<sup>13</sup>, the WHO guideline of 0.02 mg/L<sup>14</sup>, the EU parametric value of 10 µg/L<sup>15</sup>, the Health Canada drinking-water value of 0.006 mg/L<sup>16</sup>, and the Australian drinking-water value of 0.003 mg/L<sup>17</sup>. Read as 0.64 µg/L, setting aside its anomalous printed uncertainty, the Romanian maximum sits below all of them. That comparison is descriptive. It does not establish that bottled water is an unimportant route in every market, and it is not a PET migration factor.

EU 10/2011's 0.04 mg/kg specific migration limit applies to antimony in food that has contacted plastic. It is not a limit on antimony in the bottle wall, and it is not a limit on water<sup>3</sup>. No baby-bottle migration experiment was examined for this review, and no concentration is stated here for baby bottles, sippy cups, or feeding pouches.

## 7 | Polyester textiles and sleepwear

In the same Washington screen, baby bibs measured 116 and 99.6 ppm antimony, and two clothing components (jeans) measured 121 and 128 ppm<sup>1</sup>. These are total concentrations in prioritized components, not a survey of infant sleepwear.

Biver, Turner, and Filella 2021 measured both total content and release on the same six polyester textiles, bought in the European Union<sup>29</sup>. Totals by X-ray fluorescence were 125, 185, 286, 357, 452, and 471 µg/g, and the abstract rounds the top of that range to about 470 µg/g. Extraction into ISO 105-E04 artificial sweat, three 24-hour extractions at 37 °C, gave 2.572 ± 0.031, 0.904 ± 0.121, 0.480 ± 0.126, 2.477 ± 0.093, 0.402 ± 0.128, and 0.689 ± 0.154 µg/g, in the same order.

The abstract's summary of 0.1 to 1 µg/g does not cover the two extracts above 2 µg/g, and this synthesis keeps the table. The abstract puts mobilization under default parameters at about 0.05 to 2 percent of total antimony. That is release into a simulant, not dermal absorption, and the articles are not identified as infant sleepwear. The authors describe two of the six as carrying an OEKO-TEX certification. Retailer and product names in the table are not repeated.

Borca 2025 measured three polyester textiles at 286, 471, and 452 mg/kg<sup>27</sup>. One spectrum resembled senarmontite, and the other two could not be fitted. Those three totals match three of the six Biver totals. Borca cites Biver but does not say the textiles are the same objects, and this synthesis does not assert that they are.

The OEKO-TEX document in this corpus announces a STeP wastewater limit of 100 µg/L for antimony<sup>18</sup>, which is a mill-effluent concentration. Biver states that the STANDARD 100 label requires extractable antimony below 30 µg/g for clothing textiles, and that under the EU Ecolabel antimony should not exceed 260 µg/g in polyester fibres before wet processing, with a derogation for fibre from recycled PET bottles<sup>29</sup>. The units are Biver's. The STANDARD 100 annex was not examined for this review, so the 30 µg/g sentence remains Biver's citation.

Decision 2014/350/EU was examined directly. Criterion 7(a) prints 260 ppm in polyester fibres, and Appendix 1 prints extractable antimony of 30,0 mg/kg in acid sweat for products for babies and children under 3 years and, separately, the same 30,0 mg/kg for all other products<sup>65</sup>. The comma is the printed decimal mark. Those figures appear in the Government limits section; they are not a STANDARD 100 limit.

Washington Ecology Publication 15-03-039 (November 2015) found antimony in 72 percent of 50 children's clothing, footwear, and accessory components sent for metals analysis, from below 1 to 2,500 ppm, with a median of 5.9 ppm overall and 126 ppm in fabric<sup>38</sup>. The report states that 50 to 300 ppm was typical of polyester clothing. The 2,500 ppm result came from one pair of flame-resistant children's pajamas, with a bromine reading of 4.6 percent by X-ray fluorescence, and one component does not make a sleepwear survey.

A Greenpeace Research Laboratories technical report quantified antimony in all 36 polyester or polyester-blend articles it tested, at 14 to 293 mg/kg<sup>39</sup>. The executive summary gives a median of 96 mg/kg of fabric. The results text attaches "of polyester" to the same 96 mg/kg median and then prints a polyester-fraction median of 120 mg/kg, and a total row in the table prints 120. Both medians are kept. Brand names in the article list are not repeated, and the articles are not identified as infant sleepwear.

Chu and colleagues 2021 measured PET fiber at factories in Jiangsu and Zhejiang. The samples are factory fiber and cloth, not infant garments. Residual antimony averaged 207.2 mg/kg in PET chips, 178.4 mg/kg in grey fabric, and 107.9 mg/kg in dyed fabric. Those figures are total antimony in the fiber and the cloth<sup>78</sup>.

Rovira and colleagues 2015 digested 31 skin-contact garments bought in Catalonia. The set includes bodysuits and baby pyjamas together with shirts, blouses, and underwear. The mean antimony across the 31 garments was 22.3 mg/kg, in the same milligram-per-kilogram series as the magnesium mean of 129 mg/kg printed in that sentence. Antimony was higher in polyester and in cotton blended with synthetic fibre than in 100 percent cotton. No polyester fibre in the set exceeded the 260 mg/kg EU Ecolabel value the paper cites. The source page does not print a separate infant-garment mean, and it does not measure sweat-extractable antimony<sup>79</sup>.

Rovira and colleagues 2016 measured 37 skin-contact garments from the same region, including six baby bodysuits and five baby pajamas. Table 3 antimony, n = 37, was detected in 35 percent of garments, with a mean of 26.0 mg/kg and a maximum of 152 mg/kg. The mean substitutes half the detection limit for each non-detect. In 100 percent polyester, antimony was 57.7 to 152 mg/kg. Clothes containing some polyester were 45.2 to 87.0 mg/kg. Other materials were below 0.10 to 4.10 mg/kg, except sample 35, a 100 percent cotton pajama, whose concentration is not printed after a page break and is not entered here<sup>80</sup>.

Migration into acidic artificial sweat, 24 hours at 37 °C and pH 5.5, was 0.3 to 3.7 percent. The sweat summary is a mean of 0.37 mg/kg and a maximum of 5.67 mg/kg, detected in 22 percent of garments. The mean hazard quotient the authors give for antimony in polyester is 0.4 for adults, and one polyester T-shirt was above 1. That quotient is their model. These garments are not wipes<sup>80</sup>.

Sleepwear as a class therefore remains unmeasured. Rovira's two sets include baby pajamas, and neither source page prints an antimony concentration for that infant subset alone. IARC lists both flame retardants and plastics among antimony's uses<sup>5</sup>, and Stone does not identify which use explains a given clothing component. The speciation evidence examined here is Borca's split, with organic antimony in PET and senarmontite where bromine is also high, and it was not measured on infant sleepwear.

## 8 | Toys, teething items, and other mouthable plastics

Directive 2009/48/EC, tested by EN 71-3, limits migrated antimony to 45 mg/kg of toy material in Category I (dry, brittle, powder-like, or pliable), 11.3 mg/kg in Category II (liquid or sticky), and 560 mg/kg in Category III (scraped-off)<sup>2</sup>. ASTM F963 limits soluble antimony to 60 mg/kg<sup>19</sup>. Under the directive's own reading, a solid mouthable toy is scraped-off material and falls in Category III, not in the tighter liquid category, unless the material is actually liquid or sticky.

The toy measurements are sparse, and most cannot be compared with those limits. Stone reports 168 ppm antimony in one stuffed-toy component and 94 ppm in a plastic book component<sup>1</sup>. Those are totals from the screening design, and a total of 168 mg/kg cannot be compared with a migration limit of 560 mg/kg, or with 60 mg/kg soluble, without a migration test.

Turner 2018 did run EN 71-3 on second-hand plastic toys and reports migratable antimony above 100 µg/g in at least one component<sup>45</sup>; the exceedances of the EU limits that the paper names are for cadmium or lead, not for antimony. Kawamura and colleagues 2006 found antimony at 5.3 mg/kg in one baby toy or paint sample out of 55<sup>46</sup>. The Danish Environmental Protection Agency's 2005 wooden-toy survey found antimony below 6 mg/kg in every EN 71-3 extract<sup>47</sup>. No pass or fail against a certification number is stated.

Turner and Filella 2017 screened plastic consumer items by portable X-ray fluorescence and summarised total antimony, in µg/g, for items in which it was quantified. Food-and-drink plastics had a mean of 410, a median of 369, a minimum of 179, and a maximum of 893. Clothing and upholstery had a mean of 1570, a median of 317, a minimum of 90, and a maximum of 9922. Toys and hobbies had a mean of 1490, a median of 571, a minimum of 72, and a maximum of 9190. The food-and-drink row is the plastic article. Migration into food or drink was not measured, and the categories are not an infant-product survey<sup>81</sup>.

Teething items are a narrower gap. The Washington source record lists pacifiers and teething items among the product types in the survey<sup>1</sup>, but no antimony result for that subset has been extracted, and no teething-ring or pacifier antimony concentration is stated here. The EN 71-3 Category III migration limit is the instrument that would apply to a scraped-off mouthable material if a migration test existed<sup>2</sup>. No such test appears in the documents examined for this review.

## 9 | Infant formula and food

Antimony appears in the analyte lists of infant-food source records, including the UK Committee on Toxicity statement on the infant-food metals survey<sup>20</sup>, but no antimony concentration from those surveys has been extracted for this synthesis. COT's later drinking-water discussion records that the committee used the WHO tolerable daily intake of 6 µg/kg body weight per day when it reviewed that infant-food survey and the 2006 Total Diet Study<sup>21</sup>. Use of a TDI is not a concentration. Kowalczyk and colleagues 2022 restate that TDI for tea drinkers and state that tea accounted for 0.03 percent of it<sup>49</sup>, which is not an infant-formula result.

The nearest infant data are urinary biomarkers, and they do not measure formula. Pikounis and colleagues 2024 measured urinary antimony in infants fed human milk or formula and did not treat urine as an antimony exposure biomarker<sup>50</sup>. Du and colleagues 2025 print urinary antimony medians of 0.2, 0.15, and 0.68 µg/L across a control group, an added-rice formula group, and an oatmeal or rice-cereal group<sup>51</sup>; the brand in that table is not repeated. These are urine concentrations, not antimony in formula or in the water used to mix it, and the formula occurrence cell remains unknown.

## 10 | What the toxicology implies for an infant, and what it does not

Trivalent antimony is IARC Group 2A, on limited human evidence, sufficient animal evidence, and strong mechanistic evidence<sup>5</sup>. That classification is neither a wipe dose nor an oral potency. WHO's 2003 fact sheet still states that the data then in hand did not indicate oral carcinogenicity, and the fact sheet's own IARC citation is the older Group 2B reading for antimony trioxide<sup>14</sup>. Both statements stand, each with its date.

The oral reference values that exist were built on drinking-water studies of potassium antimony tartrate in adult rats, then allocated to a 60 kg adult<sup>14304</sup>. The WHO background document prints the same TDI of 6 µg/kg and the same 20 µg/L guideline, together with an oral LD50 for antimony trioxide above 20,000 mg/kg<sup>30</sup>. None of these values describes dermal contact, and Borca's PET bottles held organic antimony, not the trioxide named in the inhalation classifications<sup>27</sup>. This synthesis does not rescale the values onto an infant body weight.

Gastrointestinal absorption reference values are about 1 percent for forms other than tartrate and 10 percent for tartrate<sup>4</sup>. OECD assumes 1 percent oral absorption for diantimony trioxide at human exposure levels, from rat figures of 0.3 percent and 0.05 percent at 100 and 1,000 mg/kg<sup>34</sup>.

Dermal absorption of a wipe residue remains unmeasured. The 0.26 percent figure summarizes an unpublished in vitro study, and OEHHHA's second figure of 0.14 percent is the same study at a higher loading<sup>3435</sup>. An infant risk number derived from a wipe ppm would therefore be an invention, and this synthesis does not produce one. The cancer evidence is inhalation evidence. NTP Technical Report 590 found some evidence of carcinogenic activity in rats and clear evidence in mice after two years of antimony trioxide inhalation, and the 2018 Report on Carcinogens monograph recommends that antimony trioxide be listed as reasonably anticipated to be a human carcinogen<sup>3637</sup>. Neither finding is a skin dose.

## 11 | Microbiome

The microbiome evidence is carried over from the metal page as context. It is not a finding that infant products change gut or skin flora, and the strength of each line of evidence is stated with it.

The mechanistic chemistry comes from in vitro and environmental work. Bacterial Sb(III) oxidation uses AnoA and can use the arsenite oxidase AioAB, and arsenic efflux pumps can move antimony<sup>22</sup>. Deng and colleagues 2021, reviewing that literature, state that the genes required for antimony methylation are still unknown, even though methylated antimony has been reported from fungi, archaea, and bacteria<sup>31</sup>. Engrola and colleagues 2023 placed antimonite in the arsenite-oxidase active site and report that Sb(III) is oxidized about 6,500 times more slowly than As(III)<sup>32</sup>.

Thomas and colleagues 2011 showed that a methanogen methyltransferase, MtaA, methylates antimony in vitro<sup>52</sup>, and Kambara and colleagues 2024 identified the antimonate reductase AnrA in one *Geobacter* strain<sup>53</sup>. This is in vitro evidence, evidence from environmental isolates, and review. None of it concerns an infant or a wipe.

In mice, a 10 mg/kg gavage of potassium antimony tartrate changed bile acids and gut community structure<sup>23</sup>. The paper is internally inconsistent on alpha-diversity, and the full text confirms both statements: the results report ACE and richness elevated in the antimony group, while the discussion reports no significant alpha-diversity difference in paired comparisons. Beta-diversity  $p = 0.001$ . This is animal evidence, at a dose that is not a consumer-product dose.

In hospitalized infants, Yan and colleagues 2025 report a negative association between serum antimony and Chao1 diversity in 342 infants, without a single-metal beta in the main text<sup>25</sup>. The figure caption gives the strata as full term 95, preterm 191, and very preterm 56, and one results sentence mislabels the  $N = 191$  group as

very preterm. The printed interaction terms are Sb-Pr 2.17 (0.77 to 3.58) and Sb-U 2.14 (0.78 to 3.50). This is observational human evidence from a hospital sample, measured in serum, and it is not a wipe dose.

In saliva, antimony was associated with oral taxa and with decayed teeth in 61 children and adults<sup>24</sup>. That too is observational human evidence, confined to the mouth.

The only skin paper examined here is Zeldin and colleagues 2023. It associated antimony in EPA release inventories with pediatric atopic dermatitis billing in five north-central states (printed coefficient 0.84, against -0.014 elsewhere) and, in vitro, showed antimony inhibiting ceramide lipids in *Roseomonas mucosa* and activating TRPA1 in Schwann cells<sup>33</sup>. No antimony concentration is printed for those assays. The methods print ICD-10 L40.9, which is psoriasis, unspecified, while the title names atopic dermatitis. The evidence is ecological association plus in vitro work. It is not a diaper-area cohort, and it does not measure antimony on infant skin.

12 | Implications

For parents, the evidence shows that some wipe components in one state screening contained tens of ppm of total antimony, and that a diaper extraction panel can omit antimony entirely. It does not show which products on a shelf do this, and it does not convert the ppm into a skin dose. The water used to prepare formula is the route that already carries numeric public limits, from 0.003 mg/L to 0.02 mg/L depending on the instrument<sup>121417</sup>. Those limits are not a judgment on a wipe.

For manufacturers, at category level and without reference to any brand, a lot released on the eight elemental totals can still contain antimony if the article contains polyester or PET. Measuring antimony requires a declared basis, whether total content, extractable content, migration into a simulant, or the lotion alone, and those answers will not match one another.

For regulators, instruments already exist for drinking water, bottled water, plastic food-contact migration, toy migration, and cosmetic impurities, but they do not line up on a wipe. Applying the cosmetic 5 ppm guidance, the toy Category III migration limit, or a drinking-water MCL to a wipe sheet would change the legal object being regulated. The gap is the missing instrument for this article and this route, not a shortage of antimony numbers in other laws.

For researchers, the most useful next measurements are a probability sample of wipes with total and sweat-extractable antimony on one basis; the unpublished Roper and Stupart dermal report, or a new infant-skin study; antimony in the diaper panels that now omit it; a study whose samples are PET baby bottles; a study whose samples are polyester sleepwear; and infant-formula concentrations that are actually extracted. A diaper-area microbiome study does not yet exist.

13 | Government limits

The rows below are transcribed from the official texts. Each value is the figure as printed, with the instrument's own unit, basis, and scope. The rows set no certification number, and they are not pass-fail values for a wipe sheet.

| INSTRUMENT | VALUE AS PRINTED | UNIT | BASIS | SCOPE |
|------------|------------------|------|-------|-------|
|------------|------------------|------|-------|-------|

|                                                                                    |                 |       |                                             |                                                                                                                                                                                     |
|------------------------------------------------------------------------------------|-----------------|-------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40 CFR 141.62(b)(11), 1 July 2025 edition [55]                                     | 0.006           | mg/l  | MCL, column headed MCL (mg/l)               | Drinking water from public water systems. BAT identifiers printed beside antimony are 2 and 7.                                                                                      |
| 40 CFR 141.51(b) [56]                                                              | 0.006           | mg/l  | MCLG, column headed MCLG (mg/l)             | Non-enforceable drinking-water goal. The line sits on the page whose running head is section 141.52 because the table continues.                                                    |
| EPA NPDWR web table, last updated 31 August 2026 [57]                              | 0.006 and 0.006 | mg/L  | MCLG, and MCL or TT                         | Drinking water. The health-effects cell on this table is filled. It is not the archived fact sheet.                                                                                 |
| EPA archived consumer fact sheet [58]                                              | 6 and 6         | ppb   | MCLG and MCL                                | Drinking water. The long-term health paragraph is an unfilled template and is not quoted.                                                                                           |
| Decision (EU) 2023/1809 of 14 September 2023, Table 9 [59]                         | < 30            | mg/kg | Content in the final product, not migration | Absorbent hygiene products, voluntary EU Ecolabel. The listed chemicals shall not be present in the final product above the table. Criteria valid until 31 December 2029.           |
| Directive (EU) 2020/2184, Annex I, Part B [60]                                     | 10              | µg/l  | Parametric value                            | Water intended for human consumption. Annex III prints measurement uncertainty of 40 percent of the parametric value.                                                               |
| Directive 2009/48/EC, original Official Journal, Annex II, Part III, point 13 [61] | 45; 11,3; 560   | mg/kg | Migration                                   | Dry, brittle, powder-like or pliable toy material; liquid or sticky toy material; scraped-off toy material. The comma in 11,3 is the printed decimal mark, read in English as 11.3. |

|                                                                           |                 |       |                                                                                                |                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------|-----------------|-------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Same directive, consolidated<br>29 August 2026 [62]                       | 45; 11,3; 560   | mg/kg | Migration. The<br>antimony line is<br>flagged as original<br>text (B), not as an<br>amendment. | Same three<br>materials. A text<br>extraction of the<br>consolidated PDF<br>inserts a space<br>inside 45. The<br>original Official<br>Journal and<br>Regulation (EU)<br>2025/2509 both<br>print 45. The<br>consolidation has<br>no legal effect.<br>Repealed with effect<br>from 1 August 2030. |
| Regulation (EU) 2025/2509,<br>Annex II, Appendix, Part A,<br>point 1 [63] | 45; 11,3; 560   | mg/kg | Migration from toys,<br>components of toys,<br>or micro-structurally<br>distinct parts of toys | Same three<br>materials. Applies<br>from 1 August 2030.<br>Articles 28 to 44<br>and Articles 49 to 55<br>apply from 1 January<br>2026.                                                                                                                                                          |
| Korea MFDS Notice 2026-23,<br>children's diapers [64]                     | 60 (60 or less) | mg/kg | Migration of the<br>topsheet and of the<br>backsheet, each                                     | Children's diapers<br>and children's<br>hygiene mats only.<br>Synthetic resin and<br>paper only. Enacted<br>as Notice 2018-19 on<br>21 March 2018. The<br>cover prints 2026. 3.<br>4. The history line<br>prints 2026.03.24.                                                                    |
| Same notice, other articles<br>[64]                                       | 60 (60 or less) | mg/kg | Migration                                                                                      | Children's<br>disposable cotton<br>swabs;<br>toothbrushes;<br>dental floss, on the<br>part that can<br>contact the mouth<br>or on the floss;<br>tongue cleaners, on<br>oral-contact parts<br>excluding the<br>handle.                                                                           |
| Same notice, tattoo dyes,<br>section 21 [64]                              | 2 (2 or less)   | mg/kg | Content of a<br>restricted element                                                             | Tattoo dye. This row<br>is not the diaper<br>migration limit.                                                                                                                                                                                                                                   |
| Decision 2014/350/EU,<br>criterion 7(a) [65]                              | 260             | ppm   | Total antimony in<br>polyester fibres, raw<br>fibres before wet<br>processing                  | Voluntary EU<br>Ecolabel. Fibres<br>manufactured from<br>recycled PET bottles<br>are derogated.                                                                                                                                                                                                 |

|                                                                    |                             |                   |                                                                      |                                                                                                                                                                                                                         |
|--------------------------------------------------------------------|-----------------------------|-------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Same decision, Appendix 1 (iv) [65]                                | 30,0 and 30,0               | mg/kg             | Extractable metals, acid sweat, EN ISO 105-E04-2013                  | Products for babies and children under 3 years old, and, as a separate list, all other products including interior textiles. The comma in 30,0 is the printed decimal mark, read in English as 30.0.                    |
| Same decision, antimony trioxide back-coating derogation [65]      | 0,50                        | mg/m3             | Eight-hour workplace air value                                       | Interior textiles. Not extractable antimony in the fabric.                                                                                                                                                              |
| Same decision, consolidated 6 January 2026 [66]                    | 260; 30,0; 30,0             | ppm; mg/kg; mg/kg | The same fibre-content and acid-sweat bases as the original decision | Criteria valid until 31 December 2028. The consolidation has no legal effect.                                                                                                                                           |
| Korea KATS Notice 2022-0220, section 3.1.1 [67]                    | 60 mg/kg (60 mg/kg or less) | mg/kg             | Migration, tested by KS G ISO 8124-3                                 | Products made to be put in the mouth, or products for children under 36 months, limited to painted surfaces including coatings, synthetic resin, and paper. The PDF is a conversion from HWP, not a PDF issued by KATS. |
| KATS Annex 1, infant textiles, in force 7 March 2024, Table 2 [68] | none printed                | none              | none                                                                 | No antimony row. This annex sets no antimony limit for infant textile fabric.                                                                                                                                           |
| Japan Cabinet Order No. 334 of 1974 [69]                           | none printed                | none              | none                                                                 | The designated harmful-substance list does not name antimony. This order sets no antimony limit for household products.                                                                                                 |

No US federal limit exists for antimony in diapers or in textiles. The federal texts examined here regulate drinking water.

China GB 31701 and GB 18401 were not obtained, so no antimony value from those standards is recorded. GB/T 18885 and FZ/T 73025 were not obtained either, and no value from them is recorded.

## 14 | What the evidence does not yet show

Three gaps bound everything above. There is no accessible primary dermal absorption study: OECD and OEHTA both summarize Roper and Stupart 2006, and the report itself was not obtained.

There is no study specific to PET baby bottles. The migration papers use commercial beverage bottles, mineral water, and, in the Xu study, other PET beverages. Polyester sleepwear as a class remains unmeasured. The clothing papers cover general children's clothing and footwear, plus one flame-resistant pajama component, and the Rovira sets do not isolate the baby-pajama antimony result.

The twelve PET, fiber, clothing, plastic-article, and food-contact source pages cited above are Chapa-Martínez 2016, Keresztes 2009, Shotyk 2006, Westerhoff 2008, Tukur 2012, Shotyk 2007, Xu 2021, the 2004 EFSA AFC opinion, Chu 2021, Rovira 2015, Rovira 2016, and Turner and Filella 2017. Each figure in those paragraphs is taken from the corresponding source page. None of the twelve reports antimony in a baby wipe, so none is added to the baby-wipes synthesis.

Infant formula water is covered only indirectly, through drinking-water limits and through urinary antimony in two infant cohorts that analysed neither the formula nor the mixing water.

## 15 | What this synthesis does not rest on

It does not rest on the OEKO-TEX STANDARD 100 annex itself, or on an EPA IRIS oral reference dose. It cites the 2004 EFSA AFC opinion as the source page records it, and it does not treat that opinion's 0.04 mg/kg restriction as a wipe limit or as a measurement of antimony in a baby bottle. It does not rest on China GB 31701 or GB 18401, which were not obtained. It does not rest on a US federal limit for antimony in diapers or in textiles, because the federal texts examined here regulate drinking water and set none. It rests on no brand comparison and on no certification threshold.

It does not treat Biver's sweat extract as absorption, the OECD 0.26 percent figure as a wipe absorption fraction, or Borca's PET bottles as baby bottles. Choi's milligrams per kilogram are two calculations from an approximate mass and from a final volume the authors did not state, printed beside the authors' µg/L, and they are not a limit.

A restriction dossier on the oxide as used in electrical and electronic equipment was also examined. That dossier sets no baby-product concentration, and none of its occupational or article figures is adopted here.

## 16 | Competing interests

The Heavy Metal Index reports what the peer-reviewed and regulatory literature supports. It is operated separately from any certification program, does not evaluate or endorse brands, and does not use certification thresholds as evidence for the statements made here.

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Every source behind this finding is listed with its own source record at

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COMPETING INTERESTS

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