Background
The European Union undoubtedly has some of the best chemicals regulations in the world. Cosmetics and personal care products (from herein referred to as “cosmetics”) sold in the UK must comply with these regulations. Despite this, they can still contain chemicals which are known or suspected to cause adverse health effects, with potential links to breast cancer (1).

Chemicals and Cosmetics
People have used personal care products containing chemicals for thousands of years to enhance beauty, as medicine, as scent and in religious ritual (2). Ancient Egyptian women painted their faces with grey galena mesdemet (lead sulphide) and malachite green (copper carbonate hydroxide) and used medicinal scented ointments from myrrh, lavender, peppermint and cedar. Ancient Romans used skin creams made of beeswax, olive oil, and rosewater, and lead-based formulae to whiten their skin.

Today the cosmetics and personal care industry is worth around £250 billion per year (3). One US survey (4) found on average, American women use 12 personal care products and/or cosmetics a day. The total products they used contained 168 different chemical ingredients. Cosmetic products are used on the body from birth (e.g. nappy rash creams) onwards, by men and women, teenagers and young children. A survey recently conducted in France (5) found an even greater use of cosmetics products than in the U.S., with on average 18 cosmetics being used daily by adult pregnant women, 16 by adult non-pregnant women, 8 by adult men, 7 by girls, 5 by boys and 6 for babies under 3 years.

Cosmetics contain a range of chemicals for specific functions. They include UV filters; colourants; hardeners; preservatives (to prevent the growth of microorganisms); fragrances (parfumes); antioxidants to help prevent skin damage and to improve product stability; emollients/moisturisers to soften skin by reducing evaporation; surfactants used as foaming agents; and emulsifiers (which help water-soluble and oil-soluble ingredients mix). Ingredients can be synthetic or naturally occurring chemicals.

Many ingredients once believed safe are no longer permitted in cosmetics. Lead poisoning from cosmetics is well documented (6). Although still permitted in many countries, the EU Cosmetics Directive bans the use of lead ingredients in any cosmetic sold in the EU (7).
Some fragrance ingredients, including several synthetic nitro musks (used as alternatives to animal-derived musks), have been banned by the EU (8,9), due to their toxicity, their tendency to bioaccumulate and their environmental impact. More recently, several phthalates used as fragrances, including bis-(2-ethylhexyl) phthalate, dibutyl phthalate and benzyl butyl phthalate, were banned for use in cosmetics and children’s toys (10), following their classification as reproductive toxicants (11).

Current cosmetics regulation

One reason the EU established the Cosmetics Directive in 1976 (Directive 76/768/EC) (12) was to help protect consumers from unsafe cosmetics. In 2013, this Directive was replaced with a new regulation (Regulation (EC) No 1223/2009) (13), which unlike the older one, individual countries had to transpose into their own legal system. The new regulation is a stricter piece of legislation which covers products applied externally, such as shampoo, skincare, make-up, perfume and sunscreen, and those used for oral hygiene, including toothpaste.

The regulation bans certain ingredients entirely (14), limits the use of others (15) and specifies ingredients which, if used, must display safety warning labels. Any ingredient used as a colour (16), preservative (17) or UV filter (18) can only be used with pre-approved safety data (19). All cosmetics ingredients must comply with the EU chemicals regulation (REACH) and are assessed for their environmental impact. If ingredients are used specifically for cosmetics, animal experiments can no longer be performed to generate safety data (20). If any “serious undesirable effects” are identified once a product is marketed, the supplier or manufacturer is obliged to notify UK authorities (or those of other EU countries). Under EU law, all cosmetics/body care products must list the chemical ingredients, but many chemicals can come under a single group name such as ‘perfume’.

The EU takes a “precautionary” approach to chemicals regulation, which means to stop harm before it might occur, as distinct from prevention, where the harm is relatively certain to occur. Therefore, if it is suspected that a chemical may cause harm, steps should be taken to restrict or prohibit its use. There are currently over 1200 ingredients banned from use in cosmetics in the EU and several hundred that are restricted. This contrasts starkly with the U.S.A, who do not adopt a precautionary approach and where only 11 ingredients are prohibited or restricted (21).
Despite stringent regulations in the EU and the requirement to produce safety data, certain potentially harmful chemicals, including endocrine disrupting chemicals (EDCs), remain permitted and are used widely in cosmetics, despite evidence to suggest they may be harmful (e.g. 22, 23, 24).

EDCs affect the body’s hormones and may cause serious adverse health effects (25). These chemicals may be harmful at very low concentrations, or may combine with other chemicals to cause harm. Most chemicals on the market have not been tested for their endocrine disrupting properties. They may be causing harm without our knowledge (26). Currently, EDCs can be authorised for use under the EU Cosmetics Regulation. A review of their use was due to take place in January 2015 (27), however, as of July 2015, this review has not yet occurred due to delays in other EU regulatory processes on EDCs.

In June 2015, the EU Regulation (EC No 1272/2008) on Classification, Labelling and Packaging (CLP) came into force which included new provisions to ensure the general public were made aware of the health hazards of substances and mixtures. An example is the well known ‘skull and crossbones’ pictogram. However, cosmetics products are exempt from this regulation, even if they contain substances known to be dangerous. So, manufacturers are not required to include warnings on product labels (28).

**Cosmetics ingredients and breast cancer risk**

Some ingredients used in cosmetics may increase breast cancer risk. Most are EDCs which mimic oestrogens. Evidence to support this comes from epidemiological and toxicology studies (see below).

Oestrogens stimulate breast cell growth and proliferation. They can also contribute to the proliferation of damaged cells and along with their metabolites (metabolic break-down products), increase the likelihood of mutations which may lead to breast cancer (29). Certain chemicals found in cosmetics interfere with oestrogen levels in the body and may lead to changes in breast tissue, (similar to those caused by oestrogens), which have been associated with an increased risk of breast cancer (30). Some chemical combinations may be particularly harmful (31). Products as a whole, (ie the entire combination of chemicals, not just individual ingredients), have also been shown to act as oestrogen mimics (32). (See our website for more information on oestrogens, EDCs and breast cancer risk).

**How do chemicals from cosmetics enter our body?**

Most commonly, chemicals are absorbed through the skin. Although many ingredients cannot penetrate the epidermal (outer skin) layer, smaller compounds are capable of dermal absorption (33).
Examples include short chain parabens (34) (used as preservatives) and phthalates (35) (used as fragrances). Exposures can occur through inhalation, e.g. from hairsprays and perfumes. People are also exposed to cosmetics ingredients indirectly via the environment. Compounds (or their metabolites) excreted in urine, or those directly disposed of into the sewage system or to landfill, may enter the aquatic environment via discharged wastewater or landfill run-off (36). Biosolids, derived from sewage treatment plants, may also contain non-degraded cosmetics ingredients that contaminate soil and crops, when used as fertilizer (37). Consequently, exposures to cosmetics ingredients can occur through ingestion of contaminated food and water as well as from inhalation and skin absorption.

Human biomonitoring studies have identified cosmetics ingredients in urine (e.g. phthalates (38), triclosan and parabens (39)), breast milk (e.g. UV filters, parabens and phthalates (40)) and blood (e.g. phthalates (41)). Ingredients that bio-accumulate (build up in fatty tissues) have also been identified in human tissues, including breast tissue (e.g. aluminium (42) and parabens (43)).

Studies have shown that increased use of cosmetics is directly related to increased concentrations of urinary metabolites of cosmetics ingredients. One study, found that those who used perfume had 2.9 times higher concentration of mono-ethyl phthalate (the primary metabolite of the fragrance ingredient diethyl phthalate) in their urine than other women (44).

**Cosmetic ingredients with possible links to breast cancer**

**Parabens:** used widely as preservatives (e.g. in shampoos, face creams and body lotions) to help lengthen shelf life but have no specific cosmetic purpose. Often an ingredients list will contain one or more of the following parabens: butylparaben, methylparaben, ethylparaben and propylparaben. Parabens are known EDCs and have been linked to breast cancer (45). Recently the EU reduced permissible concentrations of butyl and propyl paraben in most cosmetic products and imposed a ban on their use in nappy creams (46). Products placed on the market since April must comply with the new rules; but existing stocks can remain on the shelves until 16 October 2015.

**Phthalates:** used as solvents for fragrance, as an alcohol denaturant (in order to render the alcohol in perfumes undrinkable) or (less commonly) to hold colour. According to Cosmetics Europe, diethyl phthalate (DEP) is the only phthalate used by the cosmetics industry in the EU (47). It can be found in perfume, nail polish and hair spray. DEP is an EDC (48); exposure may be linked to breast cancer (49, 50) and has been associated with other health problems including adverse male reproductive development (51).

**Triclosan:** used in antibacterial soaps, deodorants and toothpastes as a preservative and to reduce bacterial growth orally (in toothpaste) and on skin (in soaps). It’s an oestrogen mimic which may be linked to breast cancer (52, 53). There is no evidence that inclusion of triclosan in soaps and hand washes has any medical benefit (e.g. 54).
**Synthetic musks:** used as fragrances in perfumes, cosmetics and aftershave. In the EU, polycyclic musks, galaxolide (HHBC) and tonalide (AHTN) and nitro musk, musk ketone, are the most widely used (55). Musk ketone is concentration restricted (56); it is oestrogenic (57) and may be linked to breast cancer (58). Galaxolide and tonalide are also EDCs (59). All synthetic musks bioaccumulate, break down slowly in the environment, and have been found in human blood, fat tissue and breast milk (60).

**Aluminium:** used in antiperspirants and deodorants, lipstick and some toothpastes. Aluminium chloride and aluminium chlorohydrate are oestrogen mimics (61) and limited scientific evidence suggests they may be associated with increased breast cancer risk (62). Aluminium is toxic at high concentrations (63).

**Formaldehyde** is used at restricted concentrations as a nail hardener and in soaps, make-up and creams in the form of formaldehyde-releasing preservatives (e.g. DMDM hydantoin, diazolidinyl urea, imidazolidinyl urea and Quaternium-15) (64). Product labelling is required if content exceeds 0.05%. Formaldehyde may be released from products as an off-gas. It is a known carcinogen, and has been linked to increased breast cancer risk (65).

### Cosmetic ingredients with links to other health problems

**UV filters** such as benzophenones, ethylhexyl methoxycinnamate and homosalate are added to sunscreen products to protect skin against the damaging effects of UV light. They are also added to other products to protect from UV damage during storage. They are oestrogenic (66,67), bioaccumulate and have been detected in breast milk (68). They may also increase the skin penetration of other chemicals (69).

**Siloxanes** are inactive ingredients used in sun lotions and creams. One of the most commonly used, octamethylcyclotetrasiloxane, is a weak oestrogen mimic, linked with reproductive disorders in animal studies (70). It also bioaccumulates and is toxic (71).

**Ethanolamines** including triethanolamine (TEA) and monoethanolamine (MEA) are used to raise pH (control acidity) and as emulsifiers. TEA is used in makeup, fragrances, hair care, skins care and shaving products and sunscreens. MEA is used in hair dyes. TEA is mildly toxic and carcinogenic in mice (72). The EU prohibits diethanolamine (DEA) in cosmetics, and restricts the use of MEA and TEA due to potential cancer risk (73).
Hydroquinone is used in nail varnish and hair dyes, where it is restricted to 0.02% and 0.3% product content respectively (74). It is toxic and carcinogenic (75) and in 2001 the EC prohibited its use as a skin lightener. Toluene is found in nail polish (restricted to 25%) and is a neuro-developmental toxin (76). Butylated hydroxytoluene (BHT) is used in lipsticks and moisturisers as an antioxidant (preservative). It is an oestrogen mimic (77) and has been found to promote tumour formation in animal studies (78).

Toxic compounds not added as ingredients may still be present in cosmetics as a result of ingredient contamination or reaction by-products. Ethoxylated alcohols (emulsifying or solubilising agents) such as polyethylene glycol and polyoxyethylene used in creams or sodium laureth sulphate, used as a foaming agent in shampoos, may contain ethylene oxide, a known carcinogen which has been linked to increased breast cancer risk (79) and 1, 4 dioxane, a suspected carcinogen (80). Polyacrylamide, used as a thickener, may contain as a by-product the neurotoxin and possible carcinogen, acrylamide (81). Although the EU prohibits or restricts metals hazardous to health in cosmetic products, some products may be contaminated with a number of different heavy metals, many of which are toxic at low concentrations (82).

Are beauty salon workers at increased health risk?

Hair and beauty salon workers are exposed to numerous cosmetics on a daily basis. A comprehensive literature review on the health of hair and beauty salon workers by Women’s Voices for the Earth (83) concluded that salon workers are more likely to suffer from a range of health problems including an increased incidence of dermatitis, asthma, Alzheimer’s disease, lupus, cancers, including breast cancer, miscarriage and birth defects in their children.

In the UK, hairdressers were found to experience higher levels of musculoskeletal problems and coughs (84), and mothers’ occupational exposure to hairspray increased the incidence of hypospadias (penis abnormalities) in sons, by 2.4 fold (85). A review (86) found hair and nail salon workers in Europe (including the UK) are at an increased risk of certain cancers, including a slightly elevated risk of breast cancer, although not all studies show a link between salon work and breast cancer risk.

Reduce your risk

- Use fewer cosmetics and personal care products, and less often;
- Avoid fragranced products, which may include numerous ingredients
- Avoid skin creams and other products which contain UV filters, unless for use as sunscreens
- Avoid using aerosols (e.g. deodorants, hair sprays) that can be inhaled or leave deposits on domestic surfaces
- Use toiletries low in additives and avoid chlorinated items
- Check the list of ingredients and try to avoid products which contain any of the chemicals listed above.

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Breast Cancer UK is calling for:

- The regulation of chemicals to be strengthened and improved, based on the precautionary principle, to protect public health;
- The exposure to hazardous chemicals, including EDCs, to be recognised as preventable risk factors for breast cancer;
- Revision of the EU cosmetics regulation to restrict EDCs from use in products, similar to carcinogens and reproductive toxicants;
- An extension of EU Article 60 (87) of the REACH Regulation, to ensure EDCs are, by default, classed as Substances of Very High Concern (SVHC), for which no safe thresholds can be determined (88);
- Use of UV filters be restricted to sunscreens and not permitted for use as a preservative in everyday cosmetics products, such as skin lotion; and
- Cosmetics and personal care products no longer be exempt from the EU Regulation on Classification, Labelling and Packaging (89) and so will display hazard warnings.

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References

24. Konduracka, E. et al. (2014), op. cit.

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