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Review Article

Adverse effects of aromatherapy: A systematic review of case reports and case series

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Abstract. *Aim*: This systematic review was aimed at critically evaluating the evidence regarding the adverse effects associated with aromatherapy.

Method: Five electronic databases were searched to identify all relevant case reports and case series.

Results: Forty two primary reports met our inclusion criteria. In total, 71 patients experienced adverse effects of aromatherapy. Adverse effects ranged from mild to severe and included one fatality. The most common adverse effect was dermatitis. Lavender, peppermint, tea tree oil and ylang-ylang were the most common essential oils responsible for adverse effects.

Conclusion: Aromatherapy has the potential to cause adverse effects some of which are serious. Their frequency remains unknown. Lack of sufficiently convincing evidence regarding the effectiveness of aromatherapy combined with its potential to cause adverse effects questions the usefulness of this modality in any condition.

Keywords: Adverse effects, safety, risk, aromatherapy, systematic review, alternative medicine

1. Introduction

Aromatherapy can be defined as "the controlled use of plant essences for therapeutic purposes" [1]. Aromatherapy is sometimes delivered through diffusers, baths, compresses or inhalations; most commonly, however, it is a combination of essential oils (EOs) and gentle massage of the body surface [2].

Aromatherapy is, according to some surveys, the second commonest form of complementary and alternative medicine (CAM) in the UK [3, 4]. The reasons for this popularity are complex but the notion that aromatherapy is "natural" and therefore free of adverse effects (AEs) is certainly an important factor [5]. This assumption, however, might be misleading [6]. Direct risks might be caused by allergic reactions, photosensitivity, interactions with drugs, carcinogenicity, and toxicity after oral ingestion [7]. Caution is advised for patients with medical conditions, such as epilepsy, asthma, circulatory disorders, broken skin as well as pregnant women and children [1, 8].

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The aim of this systematic review is to provide a summary and critical evaluation of the evidence regarding AEs associated with the use of aromatherapy.

2. Method

Electronic literature searches were conducted in February 2012 to identify case series (CS) and case reports (CR) of AEs of aromatherapy in human patients. The following electronic databases were used: MEDLINE, EMBASE, AMED, CINHAL, and Cochrane Database (details of the search strategy are presented in the appendix). Our own extensive departmental files were also hand-searched for further articles.

No restrictions of language or time of publication were imposed. To be included, CS or CR had to pertain to the use of essential oils (EO) in human patients. We also considered reports where harm was associated with the use of aromatherapy as an alternative to conventional treatments. Data from spontaneous reporting system was also included. Reports of AEs associated with an accidental ingestion of EO were excluded; or EO being part of foods, fragrances or cosmetics were excluded. Information from the included CS or CRs were extracted according to pre-defined criteria and assessed descriptively by two independent reviewers. Causality was estimated by the present authors as based on the description provided by the authors of the primary articles. Any disagreements were resolved through discussion.

3. Results

Our searches generated 12015 articles, of which 11973 were excluded (Fig. 1). Forty two reports met our eligibility criteria [9–50]. Key data from the included papers are presented in Table 1.

The total number of patients who experienced AEs of aromatherapy was 71. The included articles originated from: Australia, [13, 20, 47] Austria, [30, 31] Belgium, [35] Canada, [36] Finland, [32] France, [33, 38] Germany, [12, 25, 43] Holland, [21, 22, 48] India, [50] Israel, [45] Italy, [11, 24] Morocco, [9] New Zealand, [34] Sweden, [27] Switzerland, [15, 42] Thailand, [14] Turkey, [10, 39] UK [17–19, 23, 26, 37, 40, 41, 49] and the US [16, 28, 29, 44, 46]. They were published between 1983 and 2011. All referred to directs AEs of aromatherapy and none to the use of aromatherapy as an alternative to conventional treatments.

The following EOs were suspected to have caused AEs: aniseed, bergamot, bitter orange, black cumin, camphor, canaga, cedar wood, chamomile, citronella, clove, coriander, cumin, cypress, eucalyptus, geranium, frankincense, jasmine, juniper, laurel, lavender, lemon, lemongrass, mustard, myrrth, neem, neroli, orange, oregano, palmarosa, patchouli, peppermint, pine, rose, rosemary, sage, sandalwood, star anise, tamanu, tea tree, thyme, wintergreen, yarrow and ylang-ylang. The EOs implicated most frequently were bergamot, [17, 31, 45] laurel, [10, 12, 13, 39] lavender, [13, 14, 19, 23, 29, 34, 45, 49] peppermint, [13, 14, 24, 40] tea tree oil [21–23, 27, 29, 36, 41, 44, 47–49] and ylang-ylang [13, 14, 18, 23, 32, 45].

AEs included acute pulmonary oedema, ataxia, atypical pityriasis rosea, blisters, burns, coma, seizures followed by death, convulsion, cyanosis, dermatitis, diarrhea, dyspnoea, confusion, eczema, hypotonia, lethargy, linear IgA disease, metabolic acidosis, nausea, pain, prepubertal gynecomastia, respiratory distress, skin and muscle necrosis followed by kidney damage, slurred speech, tachycardia, vomiting.

The commonest AE was skin irritation and contact dermatitis [10–14, 18, 19, 21–27, 30, 32, 33, 36, 39, 43–49]. Patients usually experienced a full recovery but there was one fatality [16]. Fourteen reports did not provide details of clinical outcomes [13, 14, 18, 21, 23, 25, 30, 32, 37, 38, 46–48]. The duration

of AEs ranged from 48 hours [20] to one year [28] Six patients required hospitalization [16, 20, 28, 35, 40–42]. In two cases skin grafts were needed [28, 40]. The commonest treatments were oral or topical steroids [10, 12, 17, 19, 24, 27, 31, 33, 39, 41, 43, 44, 49, 50]. In 5 cases, a causality link between AEs and aromatherapy was deemed likely, in 40 it was certain or almost certain.

The most common route of administration was the application of EOs to the skin (in 35 cases), followed by inhalation (5 cases), and oral ingestion in addition to topical application (3 cases). Two cases involved atypical routes of administration such as 'coining' or nasal instillation.

4. Discussion

Our review was aimed at critically evaluating the available evidence from CS and CR regarding AEs of aromatherapy. The findings suggest that aromatherapy may lead to AEs which can occasionally be serious.

Aromatherapists tend to deny any risks associated with aromatherapy [51]. Essential oils are complex mixtures (one EO may have over 100 constituents) that can be toxic at high concentrations, especially, if taken orally [5, 13]. We excluded several reports of AEs associated with the accidental intake of EOs several of which had resulted in death. Some aromatherapists advise their patients to ingest EOs in addition to topical application [52]. One fatality included in our review was most likely caused by the oral ingestion of wintergreen oil [16].

Essential oils are commonly used additives in cosmetic and personal hygiene products and they have been implicated in allergic reactions [53]. Survey data show that 23% of massage therapists had experienced hand dermatitis within the past 12-months [54]. In our review, we excluded AEs caused by EOs, if they were not related to the therapeutic use of EOs, or if they were not experienced by patients.

We did not locate reports of AEs associated with the use of aromatherapy as an alternative to conventional treatments. The preference of aromatherapy over conventional medicine when dealing with serious medical conditions clearly does have the potential to cause serious harm. The fact that no such cases have been published could be due to under-reporting or a true absence of such events. In our view, under-reporting seems a more likely explanation.

We did not include AEs reported in clinical trials of aromatherapy. It has been noted repeatedly that clinical trials of alternative therapies fail to report AEs, [55] an impression confirmed by a preliminary study of aromatherapy trials. We therefore felt that the inclusion of such (absence of) evidence would not meaningfully contribute to the overall picture and might even significantly distort it.

It seems crucial that therapeutic decisions are based on balancing the potential benefits of an intervention with its risks. With regards to the latter, our review shows that, in the majority of cases, AEs were considered mild to moderate. With regards to the former, the evidence of the effectiveness of aromatherapy for any condition fails to be convincingly positive [2]. Thus it is questionable whether the benefits of aromatherapy outweigh its risks.

Several limitations of this review need to be considered. They pertain to the potential incompleteness of the primary data. Many AEs of aromatherapy might have gone under-reported. Thus, we cannot be sure that all CS and CRs were found through the search strategy employed. The often low quality of the primary reports is another drawback. Thirteen reports lacked description of treatment and clinical outcomes [13, 14, 18, 21, 23, 25, 30, 32, 37, 38, 46–48]. A cause-effect relationship between the aromatherapy and the AEs was therefore frequently difficult to establish. We did not include systematic reviews, clinical trials, surveys and cohort studies in our review. We therefore might have missed relevant information.

Table 1
Case series and case reports of AEs of aromatherapy

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Achouri (2011) MA [9]	CR	1/30 day old infant	Juniper	Topical	Respiratory distress, hypotonia, convulsions, lethargy, hypotonia, tachycardia, dyspneia and acute pulmonary oedema	Systemic toxicity	Certain	Anticonvulsivants and diuretics. Recovery within 3 weeks
Adisen (2007) TR [10]	CR	1/36-year-old male	Laurel	Topical	Contact dermatitis	Allergic reaction	Certain	Oral steroids. Recovery within 2 weeks
Assalve (1987) ITA [11]	CR	1/45-year-old male	Aniseed	Topical	Contact dermatitis	Allergic reaction	Almost certain	Improvement after discontinuation
Athanasiadis (2007) GER [12]	CR	1/63-year-old female	Laurel	Topical	Erythema multiforme	Allergic reaction	Certain	Topical steroids. Recovery within 1 week
Bleasel (2002) AUS [13]	CS	1. 52-year-old female MT	1. Fragrance mix, geranium, frankincense, lavender, lemongrass, myrrth, neroli, palmarosa, rose and ylang-ylang	Topical	Contact dermatitis	Allergic reaction	Almost certain	n.r.
		2. 46-year-old female MT	2. as above + laurel, peppermint, sandalwood and yarrow					
		3. 45-year-old person	3. Lavender, rose and sandalwood					

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
		4. 29-year-old person	4. as 3 + canaga, geranium and ylang-ylang					
Boonchai (2007) TAI [14]	CS	1. 35-year-old female MT	1. ylang-ylang and cananga	Topical	Contact dermatitis	Allergic reaction	Almost certain	n.r.
		2. 39-year-old female MT	2. jasmine, geranium, lavender, lemongrass, and peppermint					
Burkhard (1999) CH [15]	CS	1/12-month-old girl	Eucalyptus, pine, and thyme	Topical and inhalation (bath)	Convulsion, irregular breathing, cyanosis and seizures	EO toxicity	Certain	Phenobarbital and phenytoin. Not fully recovered
Chin (2007) US [16]	CR	1/80-year-old male	Wintergreen	Topical and oral	Coma, seizures and death	Salicylate toxicity	Certain	ICU admission. Death
Clark (1998) UK [17]	CR	1/10-year-old girl	Bergamot	Topical	Blistering eruptions on hands and forearms	Photo-sensitivity of 5-methoxy-psoralen	Certain	Corticosteroids. Full recovery
Cockayne (1997) UK [18]	CR	1/32-year-old female MT	Ylang-ylang and patchouli	Topical	Contact dermatitis, eczema	Allergic reaction	Certain	n.r.
Coulson (1999) UK [19]	CS	1. 71-year-old female	Lavender	Topical	1. Acute eczema	Allergic reaction	Certain	1.Corticosteroids. Full recovery within 2 weeks
		2. 76-year-old male			2. Facial dermatitis			2. n.r.

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Darben (1998) AUS [20]	CR	1/6-year-old girl	Eucalyptus	Topical	Slurred speech, ataxia, muscle weakness, nausea, vomiting, coma	Eucalyptus oil toxicity	Certain	Hospital admission. Full recovery within 48 hours
De Groot (1992) NL [21]	CR	1/45-year-old male	Tea tree	Topical and oral	Dermatitis	Allergic reaction	Almost certain	n.r.
De Groot (1996) NL [22]	CR	1/40-year-old male	Tea tree	Inhalation	Dermatitis	Allergic reaction	Almost certain	Full recovery
Dharmagunawardena (2002) UK [23]	CS	1. 51-year-old female MT	1. Tea tree and lavender	Topical	Eczematous eruption	Allergic reaction	Certain	n.r.
		2. 52-year-old female MT	2. Lavender, cananga, rose, ylang- ylang, geranium and jasmine					
Foti (2004) ITA [24]	CR	1/60-year-old male	Peppermint	Topical	Contact dermatitis	Allergic reaction	Almost certain	Topical Corticosteroids. Recovery within 1 week
Franz (1998) GER [25]	CR	1/30-year old female	Cedar wood	Topical	Contact dermatitis	Allergic reaction	Almost certain	n.r.
Greenbalt (2011) UK [26]	CR	1/56-year-old female	Neem	Topical	Contact dermatitis	Allergic reaction	Certain	Full recovery after discontinuation
Hackzell-Bradley (1997) SWE [27]	CR	1/38-year-old female	Tea tree	Topical	Contact dermatitis	Allergic reaction	Certain	Steroids. Full recovery

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Heng (1987) US [28]	CR	1/Male (unspecified age)	Wintergreen and menthol	Topical	Necrotic blisters, skin and muscle necrosis and kidney damage	Methyl salicylate toxicity	Certain	Hospitalization, skin grafts
Henley (2007) US [29]	CS	1. 4 years 5 months old boy	Lavender and tea tree	Topical	Prepubertal gynecomastia	Estrogenic and antiandrogenic activity	Likely	1. Partial recovery within 4 moths
		2. 10 years 1 month old boy						2. Recovery within 9 months
		3. 7 years 10 months old boy						3. Recovery within a few months
Jung (2006) AU [30]	CR	1/61-year-old MT	Lemongrass and orange	Topical	Contact dermatitis and pain	Allergic reaction and skin irritation	Certain	n.r.
Kaddu (2001) AU [31]	CS	1. 54-year-old female	Bergamot	1. Topical	Painful, red, edematous, areas with bullae and crusting on the face	Photoallergy/ phototoxicity	Certain	1. Topical steroid. Marked improvement within 7 days
		2. 41-year-old female		2. Inhalation				2. Topical steroid and oral analgesics. Significant improvement within 5 days
Kenerva (1995) SF [32]	CR	1/37-year-old female	Ylang–Ylang	Topical	Dermatitis	Allergic reaction	Almost certain	n.r.

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Le Coz (2004) FRA [33]	CR	1/53-year-old female	Tamanu	Topical	Dermatitis	Allergic reaction	Certain	Topical corticosteroids. Full recovery
Maddocks-Jennings (2004) NZ [34]	CS	2/female students in their 20s	C1. Lavender, oregano and juniper	C1. Topical	C1. Hands tingled and swollen, redness to arms and throat area, shortness of breath	Allergic reaction	Likely	C1. Antihistamine treatment. Full recovery
			C2. Roman chamomile	C2. Inhalation	C2. 'head rush' light-headed, tachycardic, nauseated			C2. None. Full recovery
Melis (1989) BEL [35]	CS	13/Children (1 month-3-years 9 months old)	1. Menthol 2. Eucalyptol	1. Nasal instillation 2. Inhalation	Irritation of nasal membranes, tachycardia, dyspneia, lost of consciousness, metabolic acidosis	EO toxicity	Almost certain	ICU admission (1 case), nasal wash. Full recovery
Monthrope (2004) CAN [36]	CR	1/50-year-old female	Tea tree	Topical	Dermatitis	Allergic reaction	Almost certain	Full recovery within 6 months
Newsham (2011) UK [37]	CS	1. 49-year-old female	Neroli	Topical	Swelling and dermatitis	Allergic reaction	Almost certain	n.r.
		2. 57-year-old female						
Nosbaum (2011) FRA [38]	CR	1/56-year-old female	Cumin	Topical and oral	Systemic allergic contact dermatitis	Allergic reaction	Certain	n.r.

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Ozden (2001) TR [39]	CR	1/55-year-old female	Laurel	Topical	Dermatitis	Allergic reaction	Certain	Antihistamine, topical and systemic corticosteroids. Full recovery with 1 month
Parys (1983) UK [40]	CR	1/35 year old man	Peppermint	Topical	Burns, skin necrosis	Irritation of skin graft	Certain	Surgery-skin graft. Full recovery within 2 weeks
Perrett (2003) UK [41]	CR	1/18-year-old female	Tea tree	Topical	Linear IgA disease	Severe allergic reaction	Certain	Hospital admission. Topical dermovate and steroids. Full recovery after 5 days
Rampini (2002) CH [42]	CR	1/35-year-old male	Camphor	Topical (as a part of "coining")	Diarrhoea, vomiting, confusion	Terpenes toxicity	Certain	Hospital admission. Supportive treatment. Full recovery after 3 days
Steinmann (1997) GER [43]	CR	1/28-year-old male	Black cumin	Topical	Maculopapular eczema	Allergic reaction	Almost certain	Corticosteroids. Recovery within 2 weeks
Stonehouse (2007) US [44]	CR	1/30-year-old female	Tea tree	Topical	Contact dermatitis	Allergic reaction	Almost certain	Hydrocortisone. Recovery within 1 week

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
Trattner (2008) IL [45]	CS	1.56-year-old female	1. Lavender, cananga, rose, ylang-ylang, jasmine and cypress	Topical	Contact dermatitis	Allergic reaction	Almost certain	Patients 1-4-full recovery within 3 months
		2. 61 -year-old female MT	2. Rose, ylang-ylang, geranium, bergamot and rosemary					
		3. 43 -year-old female MT	3. Rosemary, neroli and clove					
		4. 51-year-old female	4.Lemon, rosemary, orange					
		5. 56-year-old female MT	5. Lavender					
Weiss (1997) US [46]	CR	1/39-year-old female	Fragrance mix	Topical	Dermatitis	Allergic reaction	Likely	n.r.
Williams (2007) AUS [47]	CR	1/38-year-old female	Tea tree	Topical	Contact dermatitis	Allergic reaction	Likely	n.r.
van der Valk (1994) NL [48]	CS	1.29-year-old female	Tea tree	Topical	Dermatitis	Allergic reaction	Certain	n.r.

Table 1
(Continued)

Author (year) Country (ref)	Study design	Sample size/ patient(s) description	Aromatherapeutic oil	Route of administration	Adverse event	Possible explanation	Causality*	Treatment/ Clinical outcome(s)
		2. 52-year-old female 3. 45-year-old female						
Varma (2000) UK [49]	CR	1/28-year-old female	Tea tree and lavender	Topical	Erythema and lichenification	Allergic reaction, interaction with antifungals	Likely	Miconazole nitrate, clobetasone butyrate, nystatin, oxytetracycline and emollient. Recovery within 1 month
Zawar (2005) IN [50]	CR	1/25-year-old male	Mustard	Topical	Atypical pityriasis rosea	Allergic reaction	Certain	Corticosteroids and anti-histamines. Full recovery

CR-case report, CS-case series, EO-essential oils, ICU-intensive care unit, IgA-immunoglobulin A, MT-massage therapist, RAC-retrospective analysis of cases, RRC-retrospective review of cases, *-as judged by the present author.

Crucially, this systematic review provides no information about the incidence of AEs. Studies that would allow estimates do currently not exist. Therefore we can at present only say that serious AEs seem to be rare.

In conclusion, aromatherapy has the potential to cause AEs which can occasionally be serious. Their frequency remains unknown. Lack of sufficiently convincing evidence regarding the effectiveness of aromatherapy combined with its potential to cause AEs questions the usefulness of this CAM modality in any condition.

Conflict of interest

None

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Appendix 1

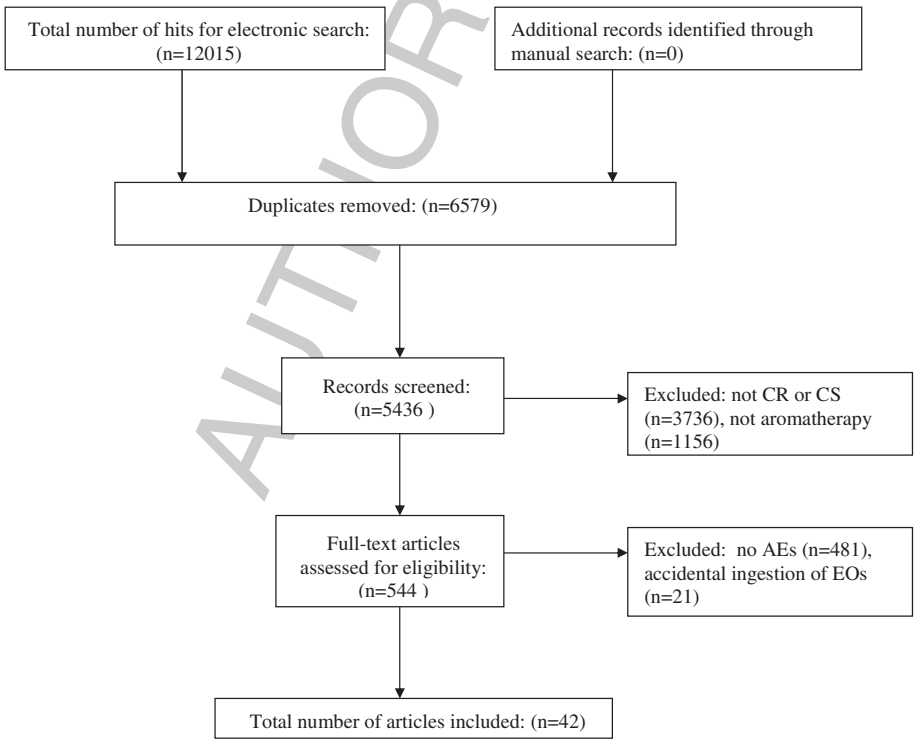

Fig. 1. Flow diagram.

Search strategy for MEDLINE

1	Aromatherap$.ti,ab.
2	((essential or massage or aroma$) adj3 Oil$).ti,ab.
3	exp Aromatherapy/
4	1 or 2 or 3
5	Burn$.ti,ab.
6	complicat$.ti,ab.
7	Irritat$.ti,ab.
8	Photosensit$.ti,ab.
9	safe.ti,ab.
10	safety.ti,ab.
11	Risk$.ti,ab.
12	Side effect$.ti,ab.
13	Allerg$.ti,ab.
14	Aggravat$.ti,ab.
15	(Adverse adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
16	(Uninten$ adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
17	(Unwanted adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
18	(Unexpected adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
19	(Undesir$ adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
20	(harm$ adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
21	(Serious adj3 (effect$ or event$ or Interaction$ or outcome$ or Reaction$ or response$)).ti,ab.
22	toxic$.ti,ab.
23	toxin$.ti,ab.
24	intox$.ti,ab.
25	Poison$.ti,ab.
26	noxious.ti,ab.
27	septic$.ti,ab.
28	hepatotoxic$.ti,ab.
29	phototoxic$.ti,ab.
30	nephrotoxic$.ti,ab.
31	carcinogenic$.ti,ab.
32	cardiotoxic$.ti,ab.
33	cytotoxic$.ti,ab.
34	Genotoxic$.ti,ab.
35	adulterat$.ti,ab.
36	contaminat$.ti,ab.
37	interact$.ti,ab.
38	pollut$.ti,ab.
39	Aftereffect$.ti,ab.
40	after effect$.ti,ab.
41	Death$.ti,ab.
42	fatal$.ti,ab.
43	exp Drug Contamination/ae [Adverse Effects]
44	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43
45	4 and 44