



Childhood poisonings: hazardous substances around the home

The natural curiosity of young children about their surroundings can sometimes lead to unintentional exposures to hazardous substances around the home. This general overview is intended to aid primary care clinicians in making decisions regarding the triage and management of children exposed to common household hazards. A focus on the assessment of household-related chlorine exposure is also included.

KEY PRACTICE POINTS:

- Household paediatric poisoning exposures are common, but most are unlikely to require medical attention or result in serious sequelae
 - Clinicians should be aware of household substances and medicines that can cause life-threatening toxicity in children in very small quantities
- Most paediatric exposures are not witnessed; management will often be based on the worst-case scenario, i.e. what is the maximum quantity of a substance that could have been ingested
- A comprehensive risk assessment of a poisoning exposure involves consideration of:
 - The route of exposure, quantity involved and toxicity of the substance
 - The age of the child and their ability to tolerate the exposure, e.g. pre-existing conditions
 - The capabilities of the medical practice, e.g. location, equipment and resources, and development of an action plan if the child's condition deteriorates
- Appropriate management and follow-up of children who have been exposed to poisons is guided by the child's current clinical condition and tailored to the type of product ingested. For example:
 - Small ingestions of gastrointestinal irritants, e.g. dishwashing liquid and toiletries, can be managed at home
 - Exposure to substances that present a serious risk of toxicity, e.g. nicotine-containing vape liquids, requires referral to the emergency department for medical assessment and observation
- If home monitoring is appropriate, parents/caregivers must be given a detailed plan, including an observation period, expected symptoms and when to seek further assistance
- Contact the **National Poisons Centre** (see box) if there is any uncertainty in the management of a poisoned child
- Any cases of exposure to household poisons should be notified to the **Hazardous Substances Surveillance System (HSSS)**; this can be done using the Hazardous Substances Disease and Injury Reporting Tool (HSDIRT) accessed via your practice management system, or by contacting your local Public Health Unit
- Primary care clinicians can use appropriate opportunities to discuss the prevention of hazardous substance exposures around the home with parents and caregivers

The National Poisons Centre

It is best practice to consult with the National Poisons Centre if there is any uncertainty regarding the treatment of a patient who has been exposed to a potentially harmful substance. Poisons Information Officers are extensively trained to aid with appropriate advice including decontamination and antidotes, relevant monitoring and overall patient management. A medical toxicologist is available 24-hours a day, seven-days a week to provide in-depth clinical advice in more complex or emergency situations.

- Phone: 0800 764 766
- Web: poisons.co.nz

Age is a significant factor in the seriousness of a poisoning exposure

Household poisoning exposures in young children frequently fall into two scenarios: (1) grabbing what is directly within their reach, or (2) medicine administration errors by parents or caregivers. Accidental poisonings are most common in children aged under three years, with the highest rate in those aged one year.¹ As children develop curiosity and mobility, their opportunities for harm increase; children can undo lids, reach bench tops and mirror parental behaviour, e.g. taking tablets.^{2,3} One common source of poisoning is children ingesting chemicals from repurposed food or drink containers (see: "Chemicals should never be put in food or drink containers").⁴ This exploratory behaviour generally begins to decline from around age five years as a child's understanding of consequences develops.² This progression can occur with different timings in children who are neurodiverse.

Most childhood poisoning exposures around the home are unlikely to require medical attention

Household paediatric poisonings are a common occurrence in New Zealand. Of the almost 20,000 separate enquiries to the New Zealand National Poisons Centre (NPC) in 2018, 77% came from residential homes and more than 50% of calls were regarding children aged under five years.⁵ While accidental ingestion of household chemicals can be highly stressful for parents, most cases of paediatric household poisoning are unlikely to require medical intervention; in 89% of poisoning enquiries involving children aged under five years and 84% of enquiries for children aged 5 – 12 years in 2018, the caller was not advised to seek medical attention by the NPC.⁵ In contrast, medical intervention was recommended for 54% of poisoning exposures in teenagers aged 13 – 19 years.⁵ This difference is potentially related to the exploratory nature of paediatric exposures, while exposures in older age groups are more likely to be intentional.⁵

 The Environmental Health Intelligence Programme NZ (EHINZ) has produced a fact sheet for unintentional hazardous substances exposures in children (0 – 14 years) reported to the NPC between 2017-19. Available here: ehinz.ac.nz/indicators/hazardous-substances/unintentional-hazardous-substance-exposures-in-children-014-years/



Although most household exposures are benign, primary care clinicians should be aware of substances that can cause significant toxicity with very small doses/volumes (Table 1). Children who have ingested these substances have the potential to become severely unwell and will likely require immediate referral for assessment and monitoring in the emergency department.

Table 1. Examples of substances that can cause significant toxicity in a child from small doses/volumes.³

Prescription medicines

- Bupropion
- Cardiac medicines, e.g. calcium channel blockers
- Clonidine
- Colchicine
- Opioids
- Sulfonylureas
- Tricyclic antidepressants

Other pharmaceuticals/substances

- Caffeine (powder)
- Imidazolines (nasal spray)
- Nicotine (liquid)
- Oil of wintergreen (methyl salicylate)

Household chemicals

- Camphor
 - Ethylene glycol (antifreeze)
 - Hydrogen peroxide ("food grade" / > 5% concentration)
 - Methanol (glass cleaner)
 - Naphthalene (mothballs)
 - Sodium hydroxide (caustic soda, lye or drain cleaner)
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Risk assessment of children exposed to poisons

Most parents/caregivers of children who are exposed to or ingest hazardous substances will contact the NPC, or present to an accident and medical clinic or emergency department. There will be occasions, however, when parents contact or present to their general practice first. After confirming that the child's airways, breathing and circulation are stable, a comprehensive risk assessment of the situation will ensure the child receives the appropriate level of care.

Initial considerations include:

- The substance
 - Solid, liquid or gas (modified or slow-release formulations if the exposure involved medicines)
 - Amount/duration of exposure – consider maximum possible exposure if the exact quantity is unknown
 - Container characteristics – can aid with estimating quantity ingested, e.g. there is greater potential for a larger ingestion of liquid stored in a soft drink bottle than stored in a bottle with a reduced flow lid
 - Concentration of substance, e.g. cleaning and gardening chemicals can be purchased either as concentrates or diluted “ready to use” products
 - Overall toxicity of substance, e.g. a taste of dishwashing liquid is not a concern, but a taste of nicotine-containing vape liquid or antifreeze (ethylene glycol) presents a serious risk of harm
 - Route of exposure – check if multiple routes of exposure were involved, e.g. a child tipping a large bottle of liquid over themselves and ingesting some in the process
 - Time of exposure – if the exact time is unknown, assume that it was the earliest possible time the exposure could have occurred
 - Container labels – ask caregivers to take pictures of the labels front and back; this information may also be able to be found online
- The child
 - Their current clinical condition – does it fit with the alleged substance ingested and the timeline provided?
 - Weight – may be required for weight-based toxicity calculations
 - Age, e.g. differences in metabolism put younger children at risk of hypoglycaemia following ethanol ingestion
 - Co-morbidities that could compromise treatment or the child’s ability to tolerate or recover from the exposure, e.g. asthma or epilepsy
 - Monitoring and recovery – can this child be managed at home, and can the caregivers seek further care if required?
- Medical centre
 - Facilities and staff – appropriate resources and training to manage worst-case scenarios
 - Distance/time to a major regional hospital with appropriate emergency and intensive care facilities – transport options available

Assume the worst: patient history can be helpful in determining a management plan but in most cases of paediatric poisoning it is unlikely that specific information regarding quantities of the substance ingested, or time of ingestion, will be accurate (unless the exposure was witnessed).^{6,7} In these situations, it is best practice to assume the worst case scenario in terms of the magnitude of exposure until proven otherwise.

Home management following low-risk paediatric poisoning exposures

The following is general advice for managing exposures to common household hazards. Specific examples of hazards and their management are given in Table 2. Contact the NPC if there is any uncertainty regarding toxicity or management following a paediatric exposure.



Ingestions of most toiletries, hand dishwashing liquid and glow stick contents are not expected to cause more than mild, self-limiting gastrointestinal upset, e.g. nausea, vomiting or diarrhoea.⁸⁻¹⁰ Following a small ingestion, parents/caregivers should be advised to rinse the child’s mouth, but withhold food and fluid for a short time and then slowly reintroduce clear liquids, to reduce the possibility of gastrointestinal upset and aspiration. Close monitoring at home by a reliable observer is appropriate. Referral to the emergency department would only be required in rare cases where the child was at risk of dehydration from severe gastrointestinal upset or if they develop symptoms of aspiration, e.g. persistent cough, stridor, dyspnoea.⁹



Dermal exposures to most household products are unlikely to result in significant injury; a notable exception would be heavy-duty oven cleaners. Affected areas of skin should be flushed with large amounts of water. Children with mild, localised erythema and pruritus can be monitored at home. Children who have ongoing pain after decontamination, blistering or persistent irritation should be medically assessed. For exposures to household corrosives that can cause chemical burns, e.g. oven cleaners, management follows the same process as for thermal burns, i.e. decontamination, keep wound clean, prevent wound drying out, monitor and manage secondary infections.¹¹

 For further information regarding chemical burns, see: [dermnetnz.org/topics/chemical-burn](https://www.dermnetnz.org/topics/chemical-burn)



Ocular exposures to most toiletries, personal cosmetic products, dishwashing liquid and glow stick contents are not expected to cause more than mild, self-limiting irritation. Medical assessment for ocular irritant exposures would only be warranted if the child remained symptomatic after appropriate decontamination and the initial monitoring period (see next paragraph). However, household grade bleaches and dishwasher powder and tablets have the potential to cause corrosive damage to the eye. Children with ocular exposures to these products should be medically assessed even if the child is asymptomatic after decontamination. If prompt decontamination is correctly carried out, it is unlikely significant symptoms will develop.^{12,13}

Decontamination and monitoring after an ocular exposure:

Flush the affected eye(s) with running water (luke-warm if possible) for up to 15 minutes, e.g. under the shower, over the sink with a jug/bottle or from a garden hose.*¹⁰ Following decontamination, caregivers should monitor the condition of the child's eye(s). Erythema will likely settle in one to two hours. If this persists, the child appears bothered by the eye, e.g. constantly rubbing, watery eyes, difficulty calming infants or non-verbal children, or there is evidence of vision disturbance, the child should be medically assessed. Exposures involving alkali products, e.g. household bleaches and dishwasher powders require medical assessment, even if the child is asymptomatic after decontamination.

* In practice, decontaminating a younger child's eyes can be challenging; in situations where caregivers are unable to accomplish any flushing at home, medical attention may be required. If available, topical anaesthetic eye drops may make decontamination more bearable for some children.¹⁴

Ocular assessment in general practice:

Conduct a general eye examination including an inspection of the eye, assessment of visual acuity (may require a symbol chart or tracking a familiar face) and fluorescein stain for evidence of corneal damage.^{15,16} Lubricating or anti-inflammatory eye drops may help to manage symptoms. Optometrist triage or referral to the emergency department may be appropriate if slit lamp microscopy or further investigation is warranted.



Inhalation of hazardous substances is seen less often in younger children, but is also a possible scenario, e.g. removing the lid of a chemical product and sniffing it, or inhaling vapour as part of a dermal exposure. In most cases, brief inhalation of household chemical vapours will result in transient upper airway irritation and mild cough. Symptoms that require medical attention include upper

airway irritation that does not settle with fresh air, persistent coughing or wheezing, tachypnoea and dyspnoea.

Provide caregivers with specific monitoring advice

In most cases children can be monitored at home either immediately or after medical assessment. Advice for the caregiver should include:

- A specific time period for monitoring the child, e.g. six hours from exposure
- Instructions to not induce vomiting if the child has ingested a substance; corrosive products can cause further damage moving back up the oesophagus and in some cases aspiration of the product may be more harmful than simple ingestion
- A discussion on whether to give food and fluid following exposure
 - Giving children large volumes of fluid immediately following an ingestion to 'dilute the poison' is not recommended
- A discussion regarding sleeping during the monitoring period; it is usually appropriate for the child to sleep/nap as per their normal schedule, but caregivers should regularly check if the child responds to cues, e.g. stirs when gently touched
- A management plan for minor (expected) symptoms that do not require medical attention
- A timeline for the development of concerning symptoms and where to seek further medical attention, e.g. the emergency department
- Symptoms that would warrant calling an ambulance
- When medicines can be re-initiated (if relevant)
- The NPC contact number if further information is required (**0800 764 766**)

Common household hazards for children

The following products in Table 2 are often found around New Zealand homes. A summary of broad management advice for paediatric exposures to these products is given; for any specific queries, contact the NPC.

Table 2. Overview of home management for household hazards.

	Household hazards	Paediatric exposure management	Symptoms that require medical attention
	<p>Boric acid-based ant baits</p> <ul style="list-style-type: none"> Contains protein or sugars to attract ants, therefore making it palatable to children “Slime”, either commercially prepared or home-made, often contains boric acid, but usually at a lower concentration than ant bait Ant baits may contain an alternative active ingredient; check toxicity with the NPC 	<ul style="list-style-type: none"> Contact the NPC for a specific weight-based calculation of toxicity Can cause gastrointestinal upset, which may be a blue/green colour¹⁷ Larger ingestions can result in an erythematous or ‘boiled lobster’ rash and progress to skin desquamation within 24 – 48 hours¹³ Maintain a reasonable fluid intake for 24 hours following exposure Dermatitis-like symptoms can be managed with emollient creams and topical corticosteroids (severe cases) 	<ul style="list-style-type: none"> Persistent gastrointestinal upset Drowsiness Rash Reduced urine output* (acute kidney injury is possible with larger ingestions) <p>* Can be difficult for caregivers to assess at home</p>
	<p>Dishwasher tablets (and powders)</p> <ul style="list-style-type: none"> Common ingredients include sodium carbonate, sodium triphosphate and sodium percarbonate¹⁸ Between 2003 and 2005, 11 children were admitted to Starship Children’s hospital after ingesting dishwasher powders; five children were treated in the paediatric intensive care unit for corrosive injuries¹⁸ Since 2006, legislation has passed aiming to reduce the risk of alkaline chemical burns, which prohibits the sale of dishwashing products with pH > 12.5^{18, 19} 	<ul style="list-style-type: none"> Small ingestions of dishwasher tablets or powder (or residue from a previous wash cycle) are unlikely to cause significant symptoms As a precaution, withhold food and fluid for at least one hour after exposure If the child is asymptomatic after one hour, start introducing small amounts of clear fluids Oesophageal injury can occur without obvious lip or oral burns 	<ul style="list-style-type: none"> Swelling or blistering of the oral cavity Chest/epigastric pain Multiple episodes of vomiting Haematemesis Drooling Dysphagia Breathing difficulties/stridor Abdominal pain or distension Refusal to feed in infants or non-verbal children Any ocular exposure
	<p>Domestic bleaches (Sodium hypochlorite)</p> <ul style="list-style-type: none"> Paediatric ingestions of bleach are generally of low toxicity, with domestic solutions commonly containing less than 6% sodium hypochlorite¹² When bleach is mixed with an acid-based cleaner, e.g. vinegar (acetic acid) or products containing citric acid, chlorine gas is released^{†12} (see: “Focus: chlorine products are common sources of household poisonings”) <p>† Ammonia-based cleaning products release chloramines when mixed with bleach (sodium hypochlorite), resulting in similar upper respiratory tract and eye irritation as chlorine gas¹²</p>	<ul style="list-style-type: none"> Large ingestions or any ingestion of products that contains more than 6% sodium hypochlorite can result in serious injury to the airway or gastro-oesophageal tract Ingestion of < 40 mL of domestic bleach in children is unlikely to cause more than minor, resolving oral irritation and mild vomiting¹² Withhold food and fluid for at least one hour after exposure If child is asymptomatic after one hour, start introducing small amounts of clear fluids Oesophageal injury can occur without obvious lip or oral burns Dermal exposure to household hypochlorite products is not expected to cause more than temporary irritation and possible bleaching of the skin, if decontamination occurs soon after exposure¹² 	<ul style="list-style-type: none"> Swelling or blistering of the oral cavity Chest/epigastric pain Multiple episodes of vomiting Haematemesis Drooling Dysphagia Breathing difficulties/stridor Abdominal pain or distension Refusal to feed in infants or non-verbal children Any ocular exposure

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Household hazards	Paediatric exposure management	Symptoms that require medical attention
 <p>Essential oils</p> <ul style="list-style-type: none"> Mixtures of volatile aromatic hydrocarbons used in aromatherapy, decongestants and cleaning products²⁰ Reduced flow lids or droppers may limit the quantity ingested in an exposure 	<ul style="list-style-type: none"> Contact the NPC for management advice for a specific product as toxicity differs between types of essential oils Any ingestion of clove oil or oil of wintergreen in young children can cause significant toxicity and requires medical assessment and observation²⁰ Small ingestion of blended oils can be closely monitored at home Minor gastrointestinal upset is possible with ingestion Withhold food and fluid for at least one hour Essential oils can cause eye and skin irritation 	<ul style="list-style-type: none"> Persistent gastrointestinal upset Persistent coughing or choking Abdominal pain Drowsiness Ataxia Seizure
 <p>Ethanol</p> <ul style="list-style-type: none"> Includes alcoholic beverages, antiseptics, window cleaners, methylated spirits, perfumes and mouth washes Hand sanitisers (60 – 80% ethanol) and methylated spirits (95 – 99% ethanol) are of particular concern due to high ethanol contents^{21,22} Ethanol metabolism occurs via different pathways in children compared to adults (due to lower levels of alcohol dehydrogenase) and is more likely to result in hypoglycaemia²³ 	<ul style="list-style-type: none"> Contact the NPC for specific weight-based calculation of toxicity The child's mouth should be rinsed Minor gastrointestinal upset is possible with ingestion Give small amount of food (e.g. white bread) 	<ul style="list-style-type: none"> Persistent gastrointestinal upset Intoxication/unusual behaviour Drowsiness
 <p>Foaming products</p> <ul style="list-style-type: none"> Includes dishwashing liquids, hand soaps, bubble blowing mixture The foaming nature of these products presents an aspiration risk⁸ 	<ul style="list-style-type: none"> Most ingestions can be monitored at home The child's mouth should be rinsed and unless specified withhold food and fluid for at least one hour Minor gastrointestinal upset is possible with ingestion 	<ul style="list-style-type: none"> Persistent gastrointestinal upset (to the point of dehydration) Coughing or choking
 <p>Irritants</p> <ul style="list-style-type: none"> Cosmetic products (e.g. make-up, moisturiser), barrier creams (e.g. Sudocrem, Bepanthen) and toiletries (e.g. shampoos, body wash) are only gastric irritants Glow stick ingredients vary slightly but can include dibutyl phthalate, oxalates and hydrogen peroxide; minimally toxic in these quantities 	<ul style="list-style-type: none"> Most ingestions can be monitored at home The child's mouth should be rinsed Minor gastrointestinal upset is possible with ingestion Small quantities of milk or yoghurt may help persistent oral irritation¹⁰ 	<ul style="list-style-type: none"> Persistent gastrointestinal upset (to the point of dehydration)
 <p>Nail polish</p> <ul style="list-style-type: none"> Usually composed of resins and dye in a solvent base with a plasticiser, e.g. cellulose²⁴ Minimally toxic to children due to viscosity and small package size²⁵ 	<ul style="list-style-type: none"> Most ingestions can be monitored at home The child's mouth should be rinsed Minor gastrointestinal upset is possible with ingestion Dermal exposure may cause minor irritation; wash off with soap and warm water (or acetone-free nail polish remover if required) 	<ul style="list-style-type: none"> Persistent gastrointestinal upset (to the point of dehydration) Drowsiness Persistent coughing Breathing difficulties

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Household hazards	Paediatric exposure management	Symptoms that require medical attention
 <p>Reed diffusers</p> <ul style="list-style-type: none"> Typically consist of an open vessel or reservoir containing 100 – 250 mL of fragrance liquid and ‘wicking reeds’, e.g. bamboo²⁶ The fragrance liquid can contain a variety of ingredients including essential oils, glycol ethers, hydrocarbons, ethanol and isopropanol²⁷ 	<ul style="list-style-type: none"> Most small ingestions can be monitored at home The child’s mouth should be rinsed, withhold food and fluid initially to let stomach settle Minor gastrointestinal upset is possible with ingestion Symptoms are not expected from sucking on the ‘reeds’²⁷ 	<ul style="list-style-type: none"> Persistent gastrointestinal upset Abdominal pain Drowsiness Persistent coughing Breathing difficulties Fever Lower back/flank pain or decreased urine output
 <p>Silica gel</p> <ul style="list-style-type: none"> The desiccants often display a warning label, e.g. ‘Do not eat’, however, this is not because the product is toxic Ingestion of the entire desiccant (including paper/cloth packaging) may pose choking or obstruction risks for children²⁸ 	<ul style="list-style-type: none"> Ingestions of silica gel granules can be monitored at home Minor gastrointestinal upset is possible with ingestion Children who ingest the entire desiccant should be assessed at the emergency department for determination of the object’s location 	<ul style="list-style-type: none"> Persistent gastrointestinal upset Abdominal pain or constipation
 <p>Superglue (Cyanoacrylate)</p> <ul style="list-style-type: none"> Cyanoacrylate adhesive exposures do not usually cause systemic toxicity but can be both painful and distressing Polymerisation (sticking) is usually rapid but adherence to the oral cavity or oesophagus is unlikely due to saliva and mucous membranes²⁹ 	<ul style="list-style-type: none"> If a child’s lips are stuck together (or their lips are stuck to their teeth), irrigate with warm water and then peel or roll lips apart; petroleum jelly (e.g. Vaseline) may help Vegetable oil or margarine may be effective to release fixed glue in the mouth Acetone can be used to dissolve hardened glue and is appropriate to use on dermal adhesions (avoid eyes)^{30, 31} A pumice stone may be used to remove hardened glue after the affected area has been soaked in warm water³¹ Caregivers should not attempt to separate child’s eyelids at home after an ocular superglue exposure 	<ul style="list-style-type: none"> Choking Tongue is stuck to lips or teeth (and removal has been unsuccessful at home) Hardened glue in the ear or nostril Any ocular exposure
 <p>Vape liquids (Nicotine)</p> <ul style="list-style-type: none"> High concentrations and liquid formulations can result in significant nicotine exposure from very small ingestions Nicotine is rapidly absorbed and severe symptoms can develop within four hours of ingestion³² 	<ul style="list-style-type: none"> All possible ingestions of liquid nicotine products in children should be referred to the emergency department for monitoring Dermal absorption is possible with prolonged skin exposure to high concentration products³² Vape liquids should be washed off the skin with water and soap as soon as possible³² Children who develop systemic symptoms require medical assessment 	<ul style="list-style-type: none"> Gastrointestinal upset Tachycardia Sweating Droping Drowsiness Pallor

Abbreviation: NPC, National Poisons Centre

Prevention of unintentional exposure to potentially hazardous substances at home



Parents/caregivers are ultimately responsible for what products they keep in their house and how they are stored. Risks are increased if caregivers do not recognise household hazards, underestimate their child's abilities to access them or overestimate the efficacy of "child-resistant" packaging. Primary care health professionals can be influential in encouraging caregivers to take a more active role in poisoning prevention.

Consider opportunities where the prevention of poisoning-related injury can be discussed with families/whānau, e.g. during a Well Child check. Specific recommendations include:^{33, 34}

- Store cleaning products and potential poisons in a cupboard that is locked, has a child resistant* catch or is out of reach (be aware of any chairs or steps that the child has access to near the cupboard)
- After using cleaning products or other chemicals immediately place them back into storage, with closures correctly fastened
- Products should always be stored in their original packaging and disposed of appropriately (see across)
- Choose (or request) products with child-resistant* packaging
- Dishwasher powder should be put into the machine last, and the door closed immediately
- When emptying dishwashers, check for, and remove left over powder residue
- Store petrol in a child-resistant* container
- Choose ready to use or diluted pesticides over concentrated products
- Know what medicines you have in the house and where they are stored; when friends or relatives come to stay, remind them to store medicines out of reach of children
- Identify what toys and gadgets (including hearing aids) around the home contain button batteries and keep these out of reach of young children

* Child-resistant does not mean child-proof

Chemicals should never be put in food or drink containers

Correct storage of household chemicals is important to prevent poisoning-related injuries.⁴ Transfer of household chemicals to food or drink containers, e.g. for storage, dilution of concentrated products or convenient access, can put both children and adults at increased risk of poisoning because the contents of these containers may be ingested (especially if mis-/unlabelled). In addition, information regarding chemical composition and first aid is no longer with the product, and the containers are unlikely to have child resistant packaging.⁴ Between 2003 and 2012, the NPC received 757 calls relating to products stored in mislabelled or non-original containers.⁴ Non-alcoholic drink bottles, e.g. soft drink or sports drink, were the most commonly used containers, while dishwashing liquid, petrol and diesel, glycols (antifreeze) and disinfectants were the most frequently reported chemicals involved in these exposures.⁴ Consider reviewing appropriate storage of household chemicals with caregivers as part of discussion regarding preventing poisoning-related injuries.



Notifying cases of household poisoning exposures

By law, injuries and diseases due to hazardous substances (Hazardous Substances and New Organisms Act 1996) must be notified to the Medical Officer of Health.

The Environmental Health Intelligence Programme NZ (EHINZ), Massey University, runs a Hazardous Substances Surveillance System (HSSS) for New Zealand. This system monitors diseases, injuries and deaths from hazardous substances exposures. Primary care notifications allow identification of substances which are causing harm and can lead to public health action to prevent disease or injury.

 For further information on the HSSS, see: www.ehinz.ac.nz/indicators/hazardous-substances

A hazardous substance is anything that can explode, catch fire, oxidise, corrode or be toxic to humans, as defined in the Hazardous Substances and New Organisms Act 1996.

N.B. This definition does not include medicines in finished dose form (and therefore over-the-counter and prescription drug overdoses), alcohol when classified as a food, chemical toxins associated with food, nor radioactive materials as these are covered by different legislation. Manufactured articles other than those including substances with explosive properties such as fireworks are also not included, e.g. batteries.

BPAC Clinical Solutions, in association with EHINZ, and funded by the Ministry of Health, has developed a Hazardous Substances Disease and Injury Reporting Tool (HSDIRT), that permits electronic reporting of all hazardous substance exposures (Figure 1).³⁵ It is available via Medtech, Indici, MyPractice and Profile practice management systems.³⁵

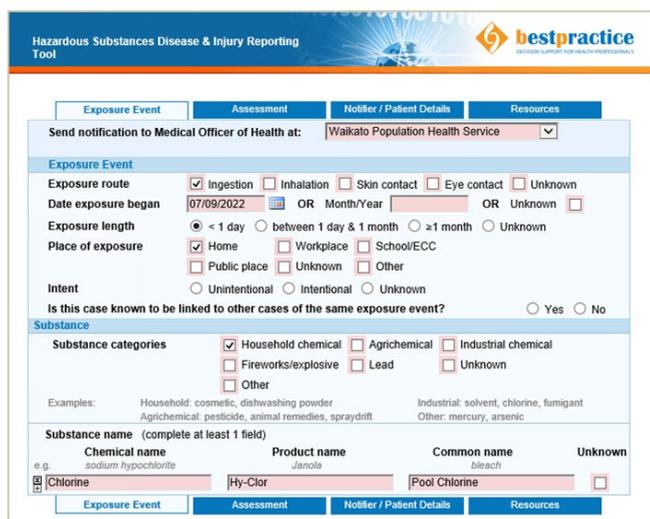


Figure 1. An example of reporting a chlorine exposure in the Hazardous Substances Disease and Injury Reporting Tool.

The notification tool will show three tabs for clinicians to complete: “Exposure Event”, “Assessment” and “Notifier/Patient Details” (Figure 1). Submitting the notification will send it to the local Medical Officer of Health via a secure system.

To access HSDIRT, go to the *bestpractice* Decision Support dashboard in your practice management system (Figure 2):

- Look for “Module List”
 - Expand the “Hazardous Substances & Lead Notifications” tab
 - Click on “Hazardous Subs & Lead Notifications”

If your practice does not have access to this tool and you want to make a notification, phone your Public Health Unit directly. The staff will enter the case information into a HSDIRT notification form on your behalf.³⁵

 For a walkthrough video explaining how to access and complete HSDIRT notification forms, see: vimeo.com/359445622

 To get *bestpractice* Decision Support software for your practice, contact the BPAC Clinical Solutions Helpdesk:

Phone: 0800 633 236

Email: itservicedesk@bestpractice.org.nz

Website contact form: bpacsolutions.co.nz/contact/

 For further information on hazardous substances disease and injury notifications, see: bpac.org.nz/BPJ/2016/May/e-notification.aspx

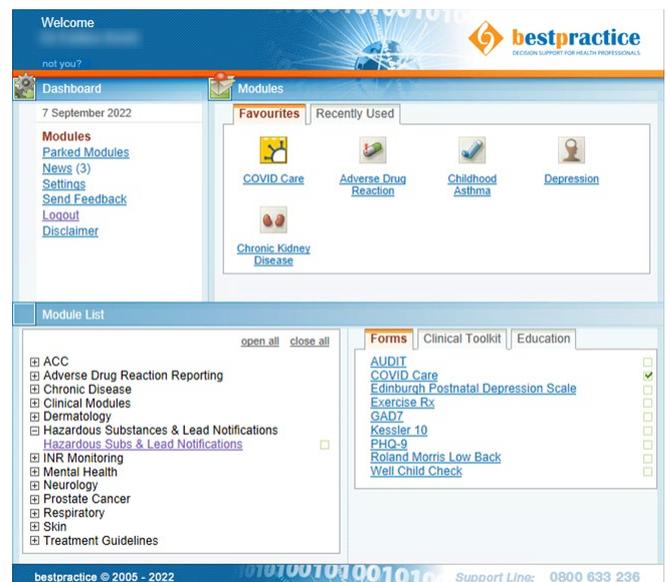


Figure 2. The *bestpractice* Decision Support dashboard.

Focus: chlorine products are common sources of household poisonings

Chlorine compounds are found around the home:



Chlorine dissolved in swimming pool water reacts with amine compounds such as sweat and urine, to form volatile chloramines, e.g. trichloramine.³⁶ Inadequate levels of chlorine disinfectants in the pool water or insufficient ventilation of indoor pools allows chloramines to build up in the water and air in the immediate vicinity, resulting in skin and eye irritation and the distinctive “pool smell”.³⁶



Improper mixing or storage of household pool chemicals can result in the unintentional release of chlorine gas and present hazards for people handling these products, e.g. chlorine gas explosion.^{37, 38} Liquids and granules can cause chemical burns if not properly washed off the skin or flushed from the eyes.³⁸



Bleach (sodium hypochlorite, NaOCl) is a staple household disinfectant and when mixed with an acid-based cleaner, e.g. vinegar (acetic acid), or products containing citric acid, chlorine gas is released.¹² Similarly, chloramines are produced when an ammonia-based cleaner is combined with bleach.¹² Chlorine or chloramine exposures can occur as a result of adding a second cleaning product to the remnants of another, e.g. in a bucket, sink or toilet bowl, or when products are combined with the goal of superior cleaning results. Exposures in confined or poorly ventilated areas, e.g. a small separate toilet or enclosed shower, have a greater risk of significant toxicity as chlorine gas is denser than air and can accumulate rapidly.³⁹

Chlorine affects mucosal surfaces

Chlorine is moderately soluble in water and its clinical effects occur as a result of the gas diffusing into fluid coating the surfaces of respiratory and ocular mucosa.⁴⁰ Chlorine gas reacts with small molecules in mucosal membranes to form hydrochloric acid (HCl), hypochlorous acid (HOCl) and oxygen free radicals.⁴⁰ These products disrupt cell membranes and proteins, damaging the respiratory tract epithelium.⁴⁰ It is also possible that chlorine reacts directly with small molecules, proteins and lipids of the respiratory surface to cause further damage.⁴¹ In lower concentrations these mechanisms result in inflammation of the upper airways.⁴² At higher concentrations, chlorine gas can infiltrate further into the distal airways and

alveoli triggering epithelial damage and inhibiting respiratory function.⁴²

Management of household chlorine exposures

In most cases, management of chlorine exposure in primary care will involve symptomatic treatment and reassurance.

Dermal exposure to chlorine



Pruritus, erythema and dry skin are commonly reported by people after swimming in incorrectly chlorinated water.⁴³ These symptoms can be more severe in susceptible patients, e.g. with eczema or another skin condition. Showering with fresh water is usually all that is required to reduce skin irritation. Persistent symptoms can be managed with antihistamines, topical corticosteroids and emollient creams.

Direct dermal exposures to solid or liquid pool chemicals can range from mild dermatitis to chemical burns. While corrosive damage is not expected from household bleaches, e.g. ~6% hypochlorite, pool chemicals often contain higher concentrations of active ingredients, e.g. ~12 % hypochlorite, and the risk of burns is increased. Higher concentrations of hypochlorite or delays in decontamination can result in more significant skin burns.¹²

Following dermal exposures to hypochlorite, it is recommended to remove any contaminated clothing and flush the affected area with water for 10 – 15 minutes.^{38, 39} Management of chemical burns follows the same process as treatment for thermal burns after decontamination.⁴⁴

Ocular exposure to chlorine



Both chlorine gas and chloramines dissolve into fluid at the eye mucosa causing irritation. Eye irritation, redness, conjunctivitis and tearing are expected from exposures to incorrectly disinfected pool water or low concentrations of chlorine gas.^{39, 43} Flushing eyes with running water for 15 minutes will be sufficient for decontamination in most situations.³⁹ If the patient remains symptomatic, they should have a medical assessment; lubricating eye drops may be appropriate to manage irritation.^{14, 38}

Direct eye contact with solid or liquid pool products can result in corneal burns.^{12, 40} Prolonged decontamination, i.e. 30 minutes, followed by medical assessment (e.g. fluorescein stain and pH testing of conjunctiva) is recommended.^{14, 45} Patients with evidence of ocular injury require an ophthalmology referral.¹⁴

Inhalation of chlorine gas



Immediate clinical features of inhaling chlorine gas, e.g. from mixing cleaning products or from pool chemicals, are nose and throat irritation, i.e. a burning sensation, cough and dyspnoea.^{40, 46} Generalised nausea, vomiting and headache are also commonly reported.^{40, 46} Upper airway irritation and coughing would be expected to improve after removal of the patient from the area to fresh air.³⁸

If mild symptoms are not resolving, or there is evidence of breathing difficulties, e.g. chest tightness or shortness of breath, medical observation (ideally in the emergency department) is recommended; deterioration is possible.³⁸ Longer duration or higher concentration chlorine gas exposures are associated with more severe respiratory symptoms, e.g. hypoxemia, haemoptysis, pulmonary oedema, metabolic acidosis, acute respiratory distress syndrome and death.^{46, 47} Symptomatic management may include administration of humidified air for patients with dyspnoea and consider bronchodilators, e.g. beta₂ receptor agonists or short acting muscarinic antagonists, for bronchospasm or wheezing.^{40, 48} Patients with persistent hypoxia or dyspnoea should be referred to secondary care for chest radiography.⁴⁸

The optimal duration of medical monitoring is unclear but up to 24 hours may be appropriate following significant exposures.⁴⁸

 **Best practice tip:** People with a history of asthma, are more susceptible to chlorine-induced respiratory inflammation and a lower threshold for medical observation in the emergency department may be appropriate.



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