Poisoning following exposure to chemicals stored in mislabelled or unlabelled containers: a recipe for potential disaster

Yvette C Millard, Robin J Slaughter, Lucy M Shieffelbien, Leo J Schep

Abstract

Aim To investigate poisoning exposures to chemicals that were unlabelled, mislabelled or not in their original containers in New Zealand over the last 10 years, based on calls to the New Zealand National Poisons Centre (NZNPC).

Methods Call data from the NZNPC between 2003 and 2012 were analysed retrospectively. Parameters reviewed included patient age, route and site of exposure, product classification and recommended intervention.

Results Of the 324,411 calls received between 2003 and 2012, 100,465 calls were associated with acute human exposure to chemicals. There were 757 inquiries related to human exposure to mislabelled or unlabelled chemicals consisting of 0.75% of chemical exposures. Adults were involved in 51% of incidents, children, <5 years 32%, 5–10 years 10%, and adolescents 5%. Child exploratory behaviour was responsible for 38% of calls and adult unintentional exposures 61%. Medical attention was advised in 26% of calls.

Conclusion Inadvertent exposure to toxic products stored in unlabelled or mislabelled containers is a problem for all age groups. Although it represents a small proportion of total calls to the NZNPC it remains a potential risk for serious poisoning. It is important that chemicals are stored securely, in their original containers, and never stored in drinking vessels.

The correct storage of poisons plays a significant role in poisoning prevention. This not only includes storing poisons in locked cupboards, but also keeping products in their original containers.

Chemical containers that are mislabelled or unlabelled may increase the chance of accidental poisoning, especially when chemicals are placed into drink containers such as soft drink (soda/pop/carbonated beverage), beer or milk bottles. In these situations there are risks of poisoning not only to children, but also adults who may presume the contents are a beverage.

This risk can be exacerbated when some chemical colours are nearly identical to the colour of the original beverage (see Figure 1). Additionally, after an exposure to an unidentified chemical it is difficult for Poisons Information Centres and medical staff to perform a risk assessment of the incident and determine appropriate medical management.1
In New Zealand it is illegal to store chemicals in food and beverage containers. The Food (Safety) Regulations 2002, Part 1 Reg 6 Misuse of Food Containers\(^2\) states that:

“No person may put, keep or sell any disinfectant, antiseptic or detergent, or a substance which could cause poisoning, in any container or package that:

a) Bears any brand, picture, word, mark or statement:
   i. indicating the presence in the container of any food; or
   ii. that is likely to mislead any person into believing that the contents of the container are intended for the purposes of human consumption; or

b) Is of a distinctive type in which articles of food have been commonly or are currently being sold, whether or not it bears any brand, picture, word, mark or statement.”

Despite the Food (Safety) Regulations there have been two well publicised incidents in New Zealand in recent years in which chemicals were placed in beverage containers. In 2009 three people drank from a water jug containing an alkaline beer line cleaner. All three patients were hospitalised, two with oesophageal burns.\(^3\)

In 2012, a benzalkonium chloride-based moss and mould cleaner was placed in a Sprite Zero® bottle at a bar. A customer was served what was believed to be lemonade from the bottle. Following ingestion of the liquid contents, the customer required medical attention.\(^4\)
Severe poisonings including deaths have occurred overseas. A man died after ingesting paraquat that was stored in a Lucozade® bottle, a 2.5-year-old boy died after ingesting diquat left in a soft drink bottle, and another 2.5-year-old boy died after ingesting endosulfan also stored in a soft drink bottle.

The aim of this study was to investigate the incidents of poisoning following exposure to mislabelled or unlabelled chemical products by retrospectively reviewing New Zealand National Poisons Centre (NZNPC) data over a 10-year period.

**Methods**

The NZNPC is the sole provider of poison information in New Zealand and receives approximately 35,000 telephone enquiries per year from throughout the country. Covering a population of approximately 4.4 million people, calls are received from both the general public and health professionals concerning acute poisoning.

An in-house computerised telephone enquiry collection database has been developed by the NZNPC. Built on Firebird™ 2.0.3 which was developed by the Firebird Project, the database is used to log information pertaining to all enquiries received by the NZNPC. This collection system utilises a poisoning incident report format and all relevant call information is entered into the database in real time as calls are received.

The current study was a single-centre retrospective review of call data from the telephone collection database regarding human acute exposures to mislabelled or unlabelled chemicals for the years 2003 to 2012 inclusively.

The retrospective review was limited to human poisoning or human exposure, excluding calls involving animal exposure, hazardous chemical inquiries (information calls without human exposure), and administrative inquiries. Calls involving mislabelled or unlabelled bottles were found using key word searches.

Data fields collected included patient age and sex, route of exposure, site of exposure, product classification, circumstances of the exposure or incident, severity of symptoms and recommended intervention.

Severity of symptoms was calculated based on The Poisoning Severity Score, developed by poisons centres around the world to evaluate poisoning cases based on the most severe clinical features. Comorbidity information such as cognitive state and visual impairment was not available.

**Results**

The NZNPC received 324,411 calls between 2003 and 2012. Chemical exposures in humans comprised 100,465 (31%) enquiries. Of these, 757 (0.75%) were human exposures to products in unlabelled or non-original containers. These enquiries were relatively steady over the 10-year period with a mean of 75.7 (SD+21.6, range 44–110) calls per year.

The receptacles most commonly used for storing chemicals were non-alcoholic drink bottles such as soft drink, water, milk and sports drink bottles. Alcoholic containers such as beer and wine bottles also featured. Seven calls involved two products being ingested from separate containers.

Adults were involved in 51% of incidents, children <5 years 32%, 5–10 years 10%, adolescents 5% and patients of unknown age 2%. The proportion of adult exposure is different to that for overall chemical exposure enquiries—i.e. for the same time period, adults only represented 35% of total chemical exposure cases.
When the age of the adult was known, adults 18 to 29 years were involved in 32% of incidents, aged 30 to 39 years 18%, 40 to 49 years 20%, 50 to 59 years 15%, 60 to 69 years 11%, and over 70 years 4%.

Ethanol intoxication did not contribute to any of the exposures in adults nor were there any other comorbidities identified. Inadvertent exposures accounted for 99% of the total exposures (61% in adults and 38% in children) while the remaining were related to self-harm.

Male patients accounted for 58% of cases and females 41%, with 1% of unknown sex. Ingestion was the main route of exposure occurring in 93% of cases; inhalation occurred in 3%, dermal in 2% and ocular exposures in 2% of cases. The majority of cases occurred at home (84%) followed by workplace exposures (11%).

Patients were asymptomatic in 59% of cases and had minor symptoms in 35% of cases. More concerning symptoms were rare with 5% of patients developing moderate symptoms, 0.3% developing severe symptoms and no fatalities reported. Corrosive injury was the cause of all 3 cases of severe poisoning. One child developed severe symptoms (Table 1).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Asymptomatic</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td>235</td>
<td>78</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Adolescent</td>
<td>22</td>
<td>15</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Adult</td>
<td>190</td>
<td>174</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>449</td>
<td>267</td>
<td>38</td>
<td>3</td>
</tr>
</tbody>
</table>

Self-treatment was the most common recommended treatment to callers (56% of cases). Medical attention was advised in 26% of cases; in some cases this was because of a lack of information available to determine the toxic risk to the patient.

The substance class or type of chemical was unknown in 9% of incidents. In 81% of incidents the substance class or type of chemical was known, but due to the container being unlabelled or mislabelled the exact product name could not be established.

Table 2 represents the most common substances that were reported to the NZNPC; these were predominantly household cleaners, vehicle fuels, and glycol based products.

Potentially significant toxic or life-threatening chemicals including cyanide, paraquat and carbaryl featured in one call each.
Table 2. Top 10 most common substances involved in unlabelled or mislabelled container incidents

<table>
<thead>
<tr>
<th>Substance name</th>
<th>Number of calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dishwashing liquid</td>
<td>51</td>
</tr>
<tr>
<td>Vehicle fuels (petrol, diesel etc.)</td>
<td>50</td>
</tr>
<tr>
<td>Glycols (antifreeze, brake fluids etc.)</td>
<td>39</td>
</tr>
<tr>
<td>Disinfectant</td>
<td>35</td>
</tr>
<tr>
<td>Bleach</td>
<td>33</td>
</tr>
<tr>
<td>Mineral turpentine</td>
<td>32</td>
</tr>
<tr>
<td>Glyphosate herbicides</td>
<td>26</td>
</tr>
<tr>
<td>Methylated spirits</td>
<td>23</td>
</tr>
<tr>
<td>Paint thinners</td>
<td>21</td>
</tr>
<tr>
<td>Multipurpose household cleaner</td>
<td>17</td>
</tr>
</tbody>
</table>

Discussion

This investigation has shown exposures to chemicals stored in unlabelled, mislabelled or non-original containers in New Zealand cross all age groups and most frequently occurs in the home setting or in the workplace. From the data, it would appear those at greater risk for poisoning are children less than 5 years and adults aged between 18 and 49 years.

Although most patients in these situations were asymptomatic or developed only mild symptoms, there is still a risk of more concerning toxicity occurring. Exposures to chemicals in unlabelled containers, particularly herbicides (e.g. paraquat), corrosive chemicals (e.g. drain cleaners), and glycols (e.g. radiator and brake fluids), can lead to more adverse clinical effects. Risks involving co-morbidities, including ethanol intoxication or cognitive and visual impairments, were not identified.

The study has also revealed that these exposures are continuing to occur despite laws prohibiting the storage of chemicals in food and beverage containers. The storage of hazardous chemicals in drink bottles can potentially cause severe poisoning or can even result in death.\(^6,7\)

In this series, the majority of poisonings (99%) were accidental and would have been prevented if chemical storage regulations had been followed. Indeed this concern has been reflected in a recent joint advertising campaign by the Environmental Protection Agency and Ministry of Business Innovation and Employment which includes internet advertising and safety videos.\(^9\)

Poison information centres play a vital role in the management of poisonings by determining the risk of potential adverse effects following an exposure; in the majority of cases, exposures have minimal or no clinically important toxic effects and information provided by the poison information centre can effectively reduce unnecessary presentations to medical centres or emergency departments.\(^10,11\)

If chemicals are stored in mislabelled or unlabelled containers it may be impossible to correctly identify the actual contents; poison information centre or emergency department staff are therefore unable to do an appropriate risk assessment following accidental ingestion.\(^1\)
In the case of an ingestion of an unknown poison, medical observation in the emergency department for the onset of adverse effects is normally recommended. This can unnecessarily consume emergency department resources if observation and investigations are not required due to the ingestion of an innocuous substance. Conversely, delays in receiving appropriate treatment such as gastrointestinal decontamination or antidote administration may occur if a potentially poisonous chemical has been ingested.

Additionally, many commercial and household products that may be potentially hazardous are required to have child-resistant closures to prevent children from being accidentally exposed. The use of child-resistant closures has been effective in reducing accidental poisoning in children, especially in the case of prescription medications. When chemicals are transferred from their original packaging to other containers such as drink bottles, these containers will no longer provide the safety that child resistant closures may afford and could be mistaken for the original beverage content, increasing the risk of an accidental poisoning occurring.

This study has highlighted ongoing concerns pertaining to the storage of chemicals in unlabelled or mislabelled containers, despite legislation designed to prevent such incidents.

More attention needs to be given to ways of reducing accidental exposures to household and other chemicals; it is important that all hazardous chemicals are stored safely and not decanted from their original containers into vessels normally used for, or associated with, drinking.

**Limitations**—There are limitations that should be taken into consideration when evaluating the results of this study. The study data only relates to enquiries received by the NZNPC and therefore may not reflect all relevant exposures in New Zealand over the study period. Cases may be missed where patients present directly to medical centres or emergency departments and physicians managing these patients may not contact the poison information centre for advice. It is also possible other cases may go undetected if parents or caregivers do not witness the exposure or do not contact the NZNPC if the incident is perceived to be minor. The exposures reported may therefore suffer from bias to some degree. In addition, as incoming enquiries to the NZNPC are not routinely followed up, our study could not provide comprehensive information on morbidity or outcome. Nonetheless, despite these limitations, our data provide insight into an ongoing potential source of poisoning in New Zealand.

**Competing interests:** Nil.

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References: