Exposures to liquid capsules (laundry, dishwashing and all-purpose cleaning)

Reports to the Dutch Poisons Information Center from 2012-2016

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Abstract

Liquid laundry capsules were introduced to the Dutch market in 2012 and have proved extremely popular among consumers. Since then other mono-dose liquid detergent capsules are marketed, including capsules for dishwashing and all-purpose cleaning. The use of this new product form resulted in a considerable number of incidents, especially with liquid laundry capsules in young children.

Public health concerns over the risks associated with liquid capsules resulted in the introduction of voluntary measures by the industry as well as in the adoption of supplementary regulatory measures by the European Union. The industry represented by the International Association for Soaps, Detergents and Maintenance products (A.I.S.E.) developed a product stewardship programme (PSP). This programme aims to ensure safe use of this product form to be achieved through packaging modifications, consumer education, and collaboration with Poisons Information Centers (PICs). In the frame of this programme A.I.S.E initiated several studies to investigate the effectiveness of the implemented voluntary measures. The European Union (EU) adopted new regulations on increased safety measures for this product group in June 2015. To monitor the effects of this new legislation, the EU started a prospective study. The DPIC is one of the participating poisons centers. This study started in October 2015 and ended in May 2016. The results will be published in 2017.

Inquiries about accidental exposures to liquid capsules are monitored by the Dutch National Poisons Information Center (DPIC) and periodically reported to the Netherlands Food and Consumer Product Safety Authority (NVWA). In this report data on exposures to liquid laundry capsules reported between 2012 and 2016, and exposures to dishwashing and all-purpose cleaning capsules reported in 2015 and 2016, are given.

From 2012 on, the number of accidental exposures with liquid laundry detergent containing capsules, has risen. In 2015 this number stabilized, and in 2016 for the first time a decrease in the number of incidents was reported. In 2016, the DPIC received 239 inquiries, resulting in a decrease of 15% compared to 2015. Exposures to liquid laundry capsules are predominantly accidental and mostly involve young children, aged 0-4 years (87.5% in 2016). Patients exposed to traditional liquid laundry detergents from bottles tend to be older. The percentage of adults (aged ≥18 yrs) exposed to bottled laundry detergents was 18%, whereas only 6% of patients exposed to laundry liquid capsules belong to this age category.

In most cases (part of) the liquid content of liquid caps is ingested. Skin and eye contact or combined routes of exposure are also reported. In laundry liquid cap exposures, ingestion in combination with eye and/or skin contact is described more often than with exposures to bottled laundry detergents.

After ingestion of (parts of) laundry liquid caps vomiting is often mentioned. Vomiting is more frequently reported after ingestion of laundry liquid caps (39%) than after ingestion of liquid laundry detergent from a bottle (16%). The occurrence of vomiting increases the risk of aspiration, and thus the risk of chemical pneumonia. In the literature chemical pneumonia is described after ingestion of liquid caps. In the cases reported to the DPIC coughing and dyspnea were seen, suggesting aspiration. However, chemical pneumonia was not reported.

In 2015 a total of 66 cases of exposure to liquid capsules not intended for laundry were reported; 49 cases involved liquid caps for dishwashing and 17 cases liquid caps for all-purpose cleaning. In 2016 a total of 74 of these cases were found; 69 cases concerning dishwashing and 5 cases concerning all-purpose cleaning capsules. Children aged 0-4 years were involved most frequently. Ingestion was the predominant route of exposure. Following ingestion vomiting was the main symptom reported (21% of the cases with dishwashing liquid caps).
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Introduction

The Dutch National Poisons Information Center (DPIC) is part of the University Medical Center Utrecht (UMC Utrecht). The main task of the DPIC is informing healthcare professionals about the possible health effects of acute intoxications and the available treatments. In 2016 the DPIC received telephone inquiries about 35,109 humans with a total of 46,342 exposures to potentially toxic substances. More than 14% of these human exposures concerned household chemicals, including liquid capsules.

In previous reports an increase in the number of liquid capsules containing laundry detergents was reported.\(^1\,^2\) This report provides an overview of data concerning the continued analysis of all exposures to liquid laundry caps in 2016 and – for comparison – liquid laundry detergents from bottles. Besides laundry products other mono-dose liquid detergent capsules are marketed, including dishwashing and all-purpose cleaning products. Information about these other product applications is also given.

Products

Laundry liquid capsules (i.e. laundry liquid caps, laundry liquid pods) enclose a measured amount of concentrated laundry detergents within a water-soluble film. The total volume usually ranges from 20 to 40 mL, which is sufficient for one wash. They are placed directly in the machine on top of the laundry and dissolve upon contact with water once the laundry cycle has started. The capsules can have one or more compartments. Separation of the content in several compartments can be used to assemble different components (e.g. detergent, stain remover, brightener) which might be incompatible if mixed in one liquid phase. The liquid in liquid caps contains detergents in concentrations higher than in liquid detergents from a bottle. In addition, in liquid caps glycols are used as solvents, to keep the water-soluble film intact. Water is the common solvent used in liquid detergents from bottles.

Dishwashing liquid capsules differ from laundry liquid capsules, because the capsules are partly solid and partly liquid (or have a gel-like consistency). They have to be placed in the dispenser of the dishwashing machine. Liquid capsules for all-purpose cleaning are completely liquid filled and should be dissolved in a bucket of water before use.

Scientific literature

In recent years several countries expressed their concern following an increased number of incidents involving liquid laundry capsules, and drew attention to adverse health effects after exposure to this product form. The frequency and severity of accidental exposures were higher than with other, more traditional forms of laundry detergents. In Europe and the United States alarming incidents were reported, with children that had to be admitted to hospital with severe respiratory symptoms after biting liquid caps followed by aspiration of the fluid. In 2015 the first fatality was reported in the United States after accidental laundry pod exposure in a 7-month-old toddler, leading to progressive central nervous system and respiratory depression complicated by profound metabolic acidosis in the absence of oropharyngeal injury. Death occurred less than 3 hours post-exposure.\(^3\) There are also indications that children suffer more local irritation at the immediate contact sites (skin, eyes, mucous membranes of the gastro-intestinal tract). Nausea, vomiting, drowsiness or lethargy, cough and foaming (in and around the mouth) are frequently reported after ingestion of (parts of) liquid caps. Erythema, rash and incidentally blisters may occur after skin contact. Eye contact usually only results in conjunctivitis, but sometimes corneal ulceration is seen.\(^4\,^5\,^6\,^7\,^8\,^9\,^10\)

Studies into the circumstances of exposure

In 2012 the International Association for Soaps, Detergents and Maintenance products (A.I.S.E.) developed a voluntary product stewardship programme (PSP). The programme aims to ensure safe
use of this product form to be achieved through packaging modifications, consumer education, and collaboration with Poisons Information Centers (PICs). In the frame of this programme A.I.S.E. has initiated several studies in cooperation with five European Poisons Centers (Dublin (Ireland), Göttingen (Germany), Milan (Italy), Prague (Czech Republic) and Utrecht (The Netherlands)). The main goal of these studies was to achieve a better understanding of the circumstances of accidental exposures with liquid capsules (laundry, dishwashing and all-purpose cleaning) in children, and investigate the effectiveness of the implemented safety measures. The first study ran from October 2014 to April 2015. Data collection was completed in spring 2015 and published in November 2015. The second study, focussing on dishwashing products only, started in October 2016 and will run for 6 months.

In the United States and Europe public health alerts about liquid laundry capsules were raised. In 2015 this resulted in a “Global Awareness-raising Campaign on Laundry Detergent Capsules”, set up by the OECD (Organisation for Economic Co-operation and Development) in participation with consumer safety authorities from five continents. This campaign was mainly aimed at informing consumers about the need for safe storage of liquid caps.

**Effects on safety measures and legislation**

In spite of the efforts of the product stewardship programme of AISE, the number and seriousness of incidents remain high and the European Commission concluded that further safety measures were necessary. New regulations on increased safety measures (EU No 1297/2014) for liquid consumer laundry detergents came into force in the European Union in June 2015. The European Commission has contracted the German Federal Institute for Risk Assessment (BfR), together with Public Health England (PHE) and the Italian National Institute of Health (INIH), to perform a prospective study in collaboration with eight European poisons centres (Bratislava (Slovakia), Dublin (Ireland), Göttingen (Germany), Lisbon (Portugal), Milan (Italy), Prague (Czech Republic), Network of Poisons Centres in France (France) and Utrecht (The Netherlands)), to monitor the effects of this new legislation. This study started in October 2015 and ended in May 2016. The results of this study will be published by the European Commission in 2017.
Methods

All cases regarding liquid laundry detergents from bottles and in caps for which the DPIC was consulted in the last 5 years (2012-2016), are included in this observational study. In addition, all consultations regarding liquid caps for dishwashing and all-purpose cleaning reported to the DPIC in 2015 and 2016 are enclosed.

For all DPIC cases included in the EU study, information about the product, the patient (age and sex), circumstances of exposure, symptoms and treatment, was prospectively collected through telephone follow-up, using standardized questionnaires. The most relevant data are incorporated in this report. The overall results of this study will be published elsewhere. For those DPIC cases not included in this multi-centre study, and for all cases included in de A.I.S.E. ADW (Automatic Dishwasher) study, only information collected at the moment of consultation of the DPIC is included.

In the Netherlands manufacturers are legally required to register product information (including composition) of their products with the DPIC. For this study, reports about registered as well as non-registered and generic brands were included.
Results

Liquid laundry capsules vs laundry detergents in bottles

Number of cases

In Figure 1 the number of reports about human exposures to liquid laundry capsules and laundry detergents in bottles is compared. The number of reported cases with exposure to liquid capsules was 126 in 2012, 237 in 2013 (+88%), 270 in 2014 (+14%), 279 in 2015 (+3%) and 239 in 2016 (-15%).

The overall number of reported incidents concerning exposure to liquid laundry detergents (liquid caps and bottles together) was 434 in 2012, 490 in 2013 (+13%), 539 in 2014 (+10%), 520 in 2015 (-3.5%) and 498 (-4%) in 2016. The raise in 2012, 2013 and 2014 was mainly attributable to the increase in the number of exposures to liquid caps.

Liquid caps were first marketed in the Netherlands in 2011, and the first accidental exposure was reported to the DPIC in February 2012. The increase observed in the bottle detergent group in 2012 is probably due to registration of liquid caps inquiries as unspecified “liquid detergent” exposures. Later on detailed product information was registered with the DPIC and more specific registration became possible. This also means that the initial rise in the number of liquid caps exposures of 88% between 2012 and 2013 most likely is an over-estimation. It is clear that from 2015 on there is a stabilization in the number of exposures to liquid caps, with even a slight decrease in 2016.
**Age distribution**

In Figure 2 the age distribution of exposures to liquid laundry caps and liquid laundry detergents from bottles is compared. The age group of 0-4 year olds is by far the most involved in these exposures. In all reported years a higher percentage of adults (aged ≥18 yrs) was observed in exposures to bottled laundry detergents (range 15-23%; 18% in 2016) as compared to exposures to capsules (range 1-6%; 6% in 2016).

![Figure 2 Exposures to laundry detergents per age category](image-url)

**Figure 2 Exposures to laundry detergents per age category**

<table>
<thead>
<tr>
<th>Year</th>
<th>Unknown</th>
<th>&gt;65 yrs</th>
<th>18-65 yrs</th>
<th>13-17 yrs</th>
<th>5-12 yrs</th>
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</tr>
</thead>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>114</td>
</tr>
<tr>
<td>2013</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>218</td>
</tr>
<tr>
<td>2014</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>246</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>253</td>
</tr>
<tr>
<td>2016</td>
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<td>0</td>
<td>0</td>
<td>10</td>
<td>5</td>
<td>209</td>
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<table>
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<th>Year</th>
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<th>Liquid caps</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>2013</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>2014</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
<td>300</td>
</tr>
</tbody>
</table>
**Routes of exposure**

In **Figure 3** the routes of exposure to laundry detergents (liquid caps and bottle) per age category are presented. It is important to mention that in this picture the total number of exposures is higher than the number of patients, because one patient can be exposed through one or more exposure routes.

![Figure 3 Routes of exposure per age category](image)

In most liquid cap cases (part of) the capsule was ingested, either as the only route of exposure (152/239 exposures; 64%) or as part of a combination of several routes of exposure (44/239 exposures; 18%). Likewise, sips from a bottle were the only exposure route (216/259 exposures; 83%) or part of more exposure routes (19/259 exposures; 7%). Eye contact was seen in 25 out of 239 (caps) and 23 out of 259 (bottles) of the cases after single route of exposure, and in 48 out of 239 (caps) and in 28 out of 259 (bottle) of the cases after combined eye-exposure. Skin contact usually occurred in combination with other exposure routes (in total 43/239 for caps and 18/259 for bottles).

The overall distribution of exposure routes in cases with bottled laundry detergents is comparable to the overall distribution of cases with liquid capsules. However, in liquid cap exposures ingestion in combination with eye and/or skin contact is described more often. This is a logical consequence of the product form. Children grab the capsule and squeeze or bite it, resulting in ingestion, skin and eye-contact.
Symptoms

Liquid laundry capsules

Figure 4 provides an overview of the symptoms (total number) that were observed after exposure (all routes) to laundry liquid caps in 2016 (239 patients).

Considering all exposure routes (239 patients), most patients remained asymptomatic (85 out of 239 patients, i.e. 36%).

Exposures to liquid capsules (laundry, dishwashing and all-purpose cleaning)

Reports to the Dutch Poisons Information Center from 2012-2016, DPIC-Report 03/2017
If only ingestion is taken into account (205 exposures), in most patients “no symptoms” were reported (88 patients, 43%), followed by vomiting (79 patients, 39%), mucous membrane irritation (17 patients, 8%), pain in mouth or throat (12 patients, 6%), coughing (11 patients, 5%) and nausea (9 patients, 4%).

Following eye exposure (48 exposures), eye irritation (22 patients, 46%) and pain in the eyes (17 patients, 35%) were reported with the highest incidence. Besides, conjunctivitis, visual impairment and edema of conjunctiva or eyelids were observed incidentally. 11 patients developed no eye-effects (26%).

Skin contact (43 exposures) usually did not result in effects on the skin (24 patients, 56%), or skin-effects were limited to redness (7 patients, 15%), mild irritation or paleness of the skin (3 patients, 7%). One patient developed chemical dermatitis and second degree burns after prolonged skin contact (wearing a t-shirt with a laundry capsule in it during 3 hours).

The total number of exposures is higher than the number of patients, because a patient can be exposed through more than one exposure routes.

Liquid laundry capsules vs bottled liquid laundry detergent

When comparing the effects after exposure to liquid caps and bottles there are some differences. After ingestion (part of) a liquid capsule, in 88 out of 205 exposures (43%) no symptoms were reported, whereas in 147 out of 235 ingestions (63%) of bottled laundry detergents no symptoms occurred. Vomiting was reported in 39% of the oral liquid cap exposures and in 16% of the oral exposures to bottled laundry detergents.

Most ingestions of laundry liquid caps only resulted in mild symptoms. In a few cases moderate effects were reported such as drowsiness (5 cases) and dyspnea (3 cases). Likewise, moderate effects including dyspnea (2 cases), stridor (1 case) and drowsiness (1 case) were incidentally reported after exposure to bottled laundry detergents.

Eye irritation was reported in 46% of eye exposures to caps and in 57% of eye exposure to bottled laundry detergents. Moderate effects (edema of conjunctiva and eyelids) were described incidentally in exposures to both caps and bottles. Serious effects on the eyes, such as corneal damage, was reported once after eye-exposure to the contents of a liquid cap and was not reported after exposure to liquid laundry detergents from a bottle. The incidence of eye irritation after exposure to laundry liquid caps was lower than expected based on the literature published. A probable explanation for the mild effects observed is that in case of hand-eye contact only small amounts of detergent got into the eye.

Skin exposure to the contents of the capsules resulted in redness/skin irritation (10 exposures) and rash/dermatitis (3 exposures). There was one patient who developed chemical dermatitis and second degree burns after prolonged contact. In 3 patients dermally exposed to bottled laundry detergent, redness/skin irritation was observed.
Liquid capsules for dishwashing and all-purpose cleaning

**Number of cases**

In **Figure 5** the number of reports about human exposures to liquid capsules used for dishwashing and all-purpose cleaning for 2015 and 2016, are given.

![Figure 5 Exposures to dishwashing and all-purpose cleaning caps in 2015 and 2016](image)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dishwashing</td>
<td>all-purpose cleaning</td>
</tr>
<tr>
<td>0-4 yrs</td>
<td>38</td>
<td>11</td>
</tr>
<tr>
<td>5-12 yrs</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>18-65 yrs</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>&gt;65 yrs</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
**Routes of exposure**

In **Figure 6** the routes of exposure per age category for dishwashing capsules in 2016 are presented. Eye exposure mainly occurred in adults, as for ingestion children aged 0-4 years were involved most often. In 2016 exposures to dishwashing capsules concerned 56 cases of ingestion, 2 case of ingestion in combination with skin exposure and 11 cases of eye exposure. All-purpose cleaning liquid caps were ingested in 3 cases and in 2 cases eye exposure was reported.

![Figure 6 Routes of exposure per age category dishwashing capsules](image)

**Symptoms**

**Figure 7** provides an overview of the symptoms that were observed in 69 patients after exposure (all routes) to dishwashing liquid caps in 2016.

Overall, 37 out of 69 patients (58%) exposed to dishwashing liquid capsules (all exposure routes) remained asymptomatic. After ingestion (58 exposures) vomiting was reported most frequently (12 exposures, 21%), followed by coughing (2 exposures, 3%). After eye contact (11 exposures) the most predominant symptoms were: eye irritation (7 exposures, 64%), pain in the eye(s) (4 exposures, 36%), visual impairment (4 exposures, 36%) and tearing (3 exposures, 27%). In 1 patient conjunctivitis was observed.

Exposures to liquid capsules for all-purpose cleaning were only reported 5 times. In three cases of ingestion, the patients had dissolved the liquid cap in water according to the user instructions, prior to the exposure. All three remained asymptomatic. After eye contact 1 patient developed irritation, pain and redness of the eyes. In the other case with eye-contact, it was unknown if symptoms occurred.
Figure 7 Symptoms (69 patients) dishwashing liquid cap exposures reported in 2016

- no symptoms
- vomiting
- eye irritation
- pain in eyes
- visual impairment
- tearing
- coughing
- symptoms unknown
- conjunctivitis
- crying
- nausea
- fever
- salivation
- pain in mouth or throat

Exposures to liquid capsules (laundry, dishwashing and all-purpose cleaning)
Reports to the Dutch Poisons Information Center from 2012-2016, DPIC-Report 03/2017
Discussion & recommendations

From 2015 on there is stabilization in the number of exposures to liquid laundry capsules reported to the DPIC, with even a slight decrease in 2016. Whether that reflects an actual decline or merely a natural variation in the number of case reports, is still unclear. Therefore continued monitoring of the number of cases is necessary. Besides, for a better and correct interpretation of the figures, data on sales volumes in the Netherlands should be taken into account. These data are not available to the DPIC.

After ingestion of (parts of) laundry liquid caps, vomiting is mentioned more often than after ingestion of traditional liquid laundry detergents from bottles. The occurrence of vomiting increases the risk of aspiration (i.e. the flowing of the detergent into the respiratory tract), and thus the risk of chemical pneumonia. However, pneumonia was not reported in our cases. In cases that were only reviewed retrospectively, the information collected shortly after ingestion is not adequate enough to definitively rule out pneumonia, as this illness can take several hours to develop. In none of our follow-up cases, including the outcome of the poisoning, aspiration pneumonia was reported.

In laundry liquid cap exposures ingestion in combination with eye and/or skin contact is described more often. This is a logical consequence of the appealing product form. Children are attracted by the caps, grab and squeeze or bite the capsule, resulting in ingestion, skin and eye contact (directly by squirting or indirectly by rubbing the eyes with contaminated fingers).

Health effects after exposure to other types of mono-dose liquid detergent capsules (dishwashing or all-purpose cleaning) appear to be less severe when compared to incidents with laundry liquid capsules. For ingestions of all-purpose cleaning capsules this can be explained by the fact that the patient often ingested the detergent after dilution in water. Exposure to dishwashing capsules in children mainly occur as a result of ingestion of residues of the capsule remaining in the dispenser of the washing machine after finishing the washing process. Exposure to these residues seems to be less dangerous.

The data about circumstances of exposure and the clinical course of liquid cap exposures gathered by follow-up, has shown a consistent pattern over the last years. In 2016 the follow-up of cases has not added new insights into the toxicity or circumstances of exposure to liquid caps. For 2017 we propose to continue to monitor the number of liquid cap exposures to the DPIC, and to make a shorter report, without follow-up data on symptoms and circumstances. Follow-up will then be limited to remarkable cases with unusual exposure circumstances and/or severe effects.
References


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