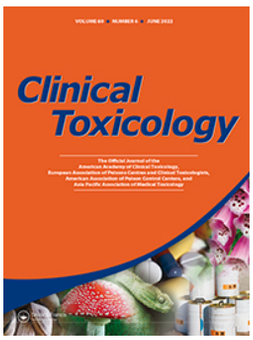

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POISON CENTRE RESEARCH

Seniors and single-use detergent sacs (SUDS): a review of the National Poison Data System from 2012 to 2020

Kim Aldy[a], Tony Du[b], Mary Madison Weaver[a], Brett Roth[a,c] and Dazhe James Cao[a,c]

[a]Department of Emergency Medicine, Division of Medical Toxicology, University of Texas Southwestern Medical Center, Dallas, TX, USA; [b]Baylor College of Medicine, Houston, TX, USA; [c]North Texas Poison Center, Parkland Health and Hospital System, Dallas, TX, USA

ABSTRACT

Introduction: Exposure to single-use detergent sacs (SUDS), or laundry pods, have declined in the pediatric population between 2015 and 2018. Older adult exposures are less well described, and it is unclear if there is an increased risk of unintentional exposure to SUDS in older adults, especially in those with dementia. This study aims to review SUDS exposures in adults greater than 60-year-old between 2012 and 2020.

Methods: Using the National Poison Data System (NPDS), a query was performed for cases involving an acute single substance exposure with substance coded as "laundry detergent unit dose" (Generic code: 0201181, 0201182, and 0201183) in adults greater than 60-years-old between January 1, 2012 and December 31, 2020. Exclusion criteria included unknown age, age less than 60 years, any multi-substance exposure, and chronic or acute-on-chronic acuity. The distribution of cases was analyzed for demographics, exposure circumstances, management, clinical effects, and medical outcome.

Results: SUDS exposure reported to NPDS increased from 46 cases in 2012 to 219 cases in 2020. Among the 1289 total reported cases, 94.9% ($n = 1223$) were unintentional exposures with an average age of 75-year-old. The majority of exposures occurred in females (69%, $n = 883$). More than 1 exposure route was reported in 90 cases (7%), and the most common route of exposure was ingestion (64.9%, $n = 836$). Major effects were identified in 1% ($n = 13$) of exposures, and 0.5% ($n = 7$) of cases resulted in death.

Conclusions: Despite a declining incidence of pediatric SUDS exposure, older adult exposures have increased over 400% between 2012 and 2020.

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Laundry pods; single-use detergent sacs; liquid laundry detergent; detergent capsules; laundry pod exposure

Introduction

Single-use detergent sacs (SUDS) for laundry, commonly known as laundry pods, have been commercially available in the United States since 2011 [1]. Most SUDS are capsules holding concentrated liquid and/or powdered detergent. Most of these outer capsules are constructed using a water-soluble, polyvinyl alcoholic membrane allowing for ease of use [1,2]. With moisture contact, the capsular membrane dissolves, readily releasing the detergent. SUDS contain anionic/non-ionic surfactants (20–35%; 10–20%), propylene glycol (8–20%), and ethanol (2–5%) – the components of which are known to result in death in previously published case studies [3–5]. This chemical combination is often sold as a brightly colored liquid detergent that is attractive to the pediatric population [1]. As a result, SUDS exposures in the pediatric population have been previously studied, with over 90,000 reported exposures between 2012 and 2020 in children < 6 years old alone [2,6–14]. SUDS exposure in the older adult population, defined as 60 years or older in this review, are less well described and have unknown relation to cognitive decline and/or ocular degeneration. Compared to adults less than 60 years old, the incidence of systemic complications and/or comorbidities are much higher in the older adult population, with corrosive-substance exposures increasing the frequency of hospitalizations in this group [15,16]. With the need for invasive diagnostics or treatment, such as endoscopy and intubation, substantial morbidity, and mortality may ensue [17].

Despite the large burden of pediatric SUDS exposure, incidence has declined in the pediatric population between 2015 and 2018 [9–12,18]. However, in older adult exposures, it is unclear if there is an increased risk of unintentional exposure to SUDS. This study aims to review SUDS exposures in adults greater than 60-year-old to characterize the demographics, exposure circumstances, management, and clinical effects to highlight risks associated with poor outcomes.

CONTACT Kim Aldy kim.aldy@gmail.com

Methods

This is a retrospective cohort study of SUDS exposure in older adults that were reported to the National Poison Data System (NPDS) between January 1, 2012 and December 31, 2020. The NPDS is a real-time surveillance database of exposure cases submitted to poison control centers around the United States.[1] A query was performed of closed human cases involving an exposure substance coded as "laundry detergent unit dose" (Generic code: 0201181, 0201182, and 0201183). Inclusion criteria involved cases in individuals 60 years or older that had an acute single substance exposure. Cases were excluded if exact age was unknown, if there were multiple substances reported, and if acuity was chronic, acute-on-chronic, or unknown. Deidentified case information retrieved from NPDS includes the following: age, gender, location of exposure, route of exposure, reason for exposure, product of exposure, reported clinical effects, level of care, disposition, and therapeutic management (Table 1). Cases were analyzed for demographics, exposure circumstances, management, clinical effects, and medical outcome. Descriptive analyses were performed using IBM SPSS Statistics for Windows version 26 (IBM Corp., Armonk, NY).

For cases with a medical outcome of death, an attempt was made to gather case records from the American Association of Poison Control Centers (AAPCC) either through a request for deidentified records from individual poison centers, or by viewing the NPDS Annual Report fatality abstracts [8,9,11,12,14]. This project was deemed exempt by the University of Texas Southwestern Medical Center Institutional Review Board.

Results

From January 1, 2012 to December 31, 2020, the NPDS received 1289 reported SUDS cases meeting the inclusion and exclusion criteria. Cases increased annually overall, with an increase from 46 cases in 2012 to 219 cases in 2020 (Figure 1).

Table 2 indicates the case demographics, intent, route, scenario, symptoms, therapies, and medical outcomes. The average age was approximately 75-year-old (range: 60–102 years). Females made up the majority of cases (69%, $n = 883$). Unintentional exposures occurred in 94.9% ($n = 1223$) of cases while intentional exposures accounted for 3.3% ($n = 43$). Routes of exposure included ingestion, ocular, dermal, inhalation/nasal, and rectal. Multiple routes of exposure were reported in 90 cases (7%). The most common route, ingestion, was 64.9% ($n = 836$) of the cohort, of which 95.3% ($n = 797$) were unintentional ingestions. Clinical scenarios for unintentional exposures were reported in 187 cases, with similar average age and sex to that of the overall cohort (average age 75 years, Females 62%). The three most reported scenarios among unintentional exposures ($n = 1223$) were confusion or mental incompetence in 12% ($n = 147$), SUDS stored improperly in 1.5% ($n = 18$), and mistaking the product for a pill or food in 1.4% ($n = 17$). The average age for those with reported confusion or mental incompetence was similar to the overall cohort (average age 77) and females also made up the majority of this group (52%).

Vomiting was the most common symptom, reported in 20.6% ($n = 265$) of all cases. Other gastrointestinal symptoms reported were nausea (6.1%, $n = 78$), diarrhea (8.8%, $n = 114$), abdominal pain (2.2%, $n = 29$), and blood per rectum (0.1%, $n = 1$). Pulmonary and respiratory symptoms included: coughing/choking (4.9%, $n = 63$), dyspnea (1.6%, $n = 21$), respiratory depression/arrest (1.2%, $n = 16$), pneumonitis and/or pulmonary edema (1.2%, $n = 15$), excess secretions (1.2%, $n = 15$), bronchospasm (0.3%, $n = 4$), and oropharyngeal edema (0.4%, $n = 5$). Respiratory depression and/or arrest occurred mostly after an ingestion (1.4%, $n = 12$).

Of the overall cohort, 35.1% ($n = 452$) were managed in an emergency department. The majority of these were treated, evaluated, and released (62.4%, $n = 282$). Of the hospitalized cases (22.1%, $n = 100$), 62% ($n = 62$) were admitted to a noncritical care unit and 38% ($n = 38$) were admitted to the critical care unit.

Post-exposure therapeutic interventions most commonly included diluting, irrigating, or washing (75.2%, $n = 969$). Intubation was only associated with cases of ingestion (0.9%, $n = 12$). Among cases leading to intubation, only two of them had respiratory depression and/or respiratory arrest. In the remaining ten cases of intubation, six had coughing or oral irritation, and four had vomiting. Positive x-ray findings, such as infiltrates indicating aspiration, were reported in 1.3% ($n = 17$) of all cases, all of which were associated with ingestion.

The most common outcome reported was minor effects (31.4%, $n = 405$). No effects occurred in 11.7% ($n = 151$). Thirteen cases involved major effects (1%), and death resulted in seven cases (0.5%). Cases not followed with no to minor effects expected and those unable to follow with major effects expected were listed in 39.4% ($n = 508$) and 3.3% ($n = 42$), respectively.

All seven fatalities were after unintentional ingestion. Of the seven deaths, NPDS Annual Report fatality abstracts were published on two cases, and fatality listings with limited information were published on the remaining five cases [8,9,11,12,14]. Deidentified poison center records were obtained in one of the limited cases for additional information. Of the three cases with known past medical history, all three had a history of dementia. Hypoxia and hypotension were common developments amongst the three cases prior to death. There was a notable difference among the timeline of these three cases, ranging from 18 h to approximately 90 h between the initial ingestion and time of death. The Relative Contribution to Fatality (RCF) published by the

[1]The American Association of Poison Control Center (AAPCC) maintains the NPDS, which houses de-identified case records of self-reported information collected from callers during exposure management and poison information calls managed by the countries poison control centers (PCCs). NPDS data do not reflect the entire universe of exposures to a particular substance as additional exposures may go unreported to PCCs; accordingly, NPDS data should not be construed to represent the complete incidence of U.S. exposures to any substance(s). Exposures do not necessarily represent a poisoning or overdose and AAPCC is not able to completely verify the accuracy of every report. Findings based on NPDS data do not necessarily reflect the opinions of AAPCC.

Table 1. Definitions of NPDS variables[a].

Variable	Definition
Cause of exposure	
Unintentional	Inadvertent exposure to SUDS.
Intentional	Deliberate exposure to SUDS.
Other	Exposure to SUDS either due to contamination/tampering, malicious reasons, adverse reactions, or unknown reasons.
Exposure routes	
Ingestion	Exposure of SUDS to the gastrointestinal tract.
Ocular	Exposure of SUDS to the ocular area.
Dermal	Exposure of SUDS to the skin.
Inhalation/nasal	Exposure of SUDS to the nasal cavity.
Rectal	Exposure of SUDS to the rectal cavity.
Clinical scenario prior to exposure	
Patient confused/mentally incompetent	Patient has a known history of dementia/Alzheimer's.
Container transfer	SUDS was moved from original container to unlabeled container or was found in an incorrectly labeled container.
Product stored inappropriately	SUDS was stored in an inappropriate manner that is other than above.
Suspected connection with SUDS	Patient has an illness of unknown etiology and with suspected connection with SUDS in the environment.
Clinical symptoms	
Vomiting	Any form of emesis as a result of exposure to SUDS.
Ocular irritation/pain	Any effect on the eyes (e.g., blurred vision and pain).
Throat irritation	Any effect on pharynx (e.g., throat pain and scratchiness).
Diarrhea	Frequent discharge of bowels, commonly in liquid form. Separated from vomiting due to frequency of these symptoms.
Nausea	Any form of nausea as a result of exposure to SUDS.
Therapies utilized	
Dilute/irrigate/wash	Flushing the eyes from the detergent using water for any amount of time.
Food/snack	Individual given food and/or snacks to cope with any of the symptoms.
Fluids/IV	Administration of fluids either orally or intravenously.
Antibiotics	Administration of antibiotics by any route.
Oxygen	Any form of administration of supplemental oxygen (e.g., nebulizer, BiPAP, intubation, and nasal cannula).
Medical outcome	
No effects	The patient exhibited no symptoms as a result of SUDS exposure.
Minor effects	The patient exhibited some symptoms as a result of the SUDS exposure, but these were not bothersome to the patient and/or resolved rapidly.
Moderate effects	The patient exhibited some symptoms as a result of the SUDS exposure that were more pronounced or prolonged, and more systemic than minor effects.
Major effects	The patient exhibited symptoms as a result of the SUDS exposure that were life-threatening, or resulted in residual disability or disfigurement.
Death	The patient died as a result of SUDS exposure.
Unrelated effect	Based upon all the information available, the SUDS exposure was probably not responsible patients symptoms.
Not followed, judged as nontoxic exposure	The patient was not followed to a final outcome, but clinical effects were not expected.
Not followed, minimal clinical effects possible	The patient was not followed to a final outcome, but no more than minor effects were expected.
Unable to follow, judged as a potentially toxic exposure	The patient could not be followed to a final outcome after a concerning toxic exposure.

[a]Adapted from: American Association of Poison Control Centers. National Poison Data System (NPDS): NPDS Coding Users' Manual version 3, 2014.

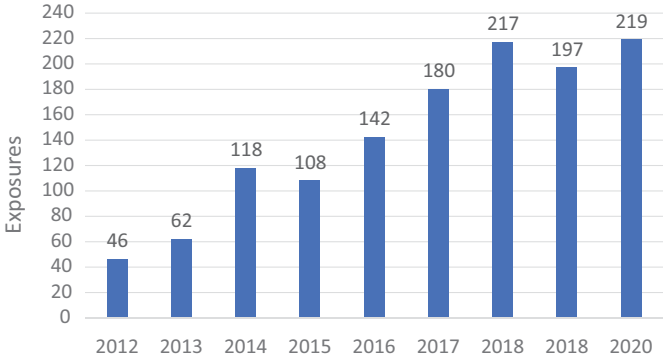

Figure 1. Older adult SUDS exposures reported from 2012 to 2020 ($n = 1289$).

AAPCC was undoubtably responsible in two cases, probably responsible in three cases, and contributory in two cases.

Discussion

Despite a declining incidence of pediatric SUDS exposure between 2015 and 2018, we have shown that older adult exposures have increased over 400% between 2012 and 2020 [9–12,18]. Peer-reviewed publications including the older adult population are sparse. When included, it is a small percentage of the overall SUDS exposure cohort [19]. We believe our publication to be the first to examine SUDS ingestions in older adults.

The majority of exposures in this cohort were classified as unintentional ingestions, including the seven fatalities reported. Confusion or mental incompetence was reported in 12% of unintentional ingestions in this cohort. The three cases of death with known past medical history indicate dementia was an underlying condition that may have played

Table 2. SUDS exposure demographics, intent, route, scenario, symptoms, therapies, and outcomes.

	Mean (minimum–maximum)
Age (mean)	75 (60–102)
	N (%)
Gender	
Female	883 (69)
Male	406 (31)
Exposure intent	
Unintentional	1223 (94.9)
Intentional	43 (3.3)
Other	18 (1.4)
Unknown	5 (0.4)
Exposure Route[a]	
Ingestion	836 (64.9)
Dermal	279 (21.6)
Ocular	238 (18.5)
Aspiration with ingestion	15 (1.2)
Inhalation/nasal	13 (1.0)
Rectal	1 (0.1)
Clinical scenario prior to exposure[b]	
Confused/mentally incompetent	147 (12.0)
SUDS stored inappropriately	18 (1.5)
Mistaken SUDS for a food or pill	17 (1.4)
Exposure occurred during routine product use	4 (0.3)
Illness of unknown etiology, with suspected SUDS connection	4 (0.3)
Most commonly reported clinical symptoms[c]	
Vomiting	265 (20.6)
Ocular irritation/pain	207 (16.1)
Throat irritation	134 (10.4)
Diarrhea	114 (8.8)
Red eye/conjunctivitis	101 (7.8)
Most commonly reported therapies[d]	
Dilute/irrigate/wash	969 (75.2)
Food/snack	117 (9.1)
Intravenous fluids	67 (5.2)
Antibiotics	60 (4.7)
Oxygen	43 (3.3)
Medical outcome	
No effects	151 (11.7)
Minor effects	405 (31.4)
Moderate effects	127 (9.9)
Major effects	13 (1.0)
Death	7 (0.5)
Not followed, no to minimal clinical effects expected	508 (39.4)
Unable to follow, potentially toxic exposure	42 (3.3)
Unrelated effect, exposure probably not responsible	36 (2.8)

[a]Cases often have multiple exposure routes. Includes cases with more than 1 exposure route ($N = 90$).
[b]Cases may exhibit a combination of factors leading to exposure. Based on $N = 187$ cases reporting a clinical scenario out of 1223 unintentional exposures.
[c]Cases often reported multiple symptoms. Top 5 clinical symptoms represented.
[d]Cases often reported multiple therapies. Top 5 treatments represented.

a significant role in unintentional SUDS ingestion. Though confusion or mental incompetence represents a small percentage of this overall cohort, patient demographics between the overall cohort and the smaller cohort with reported confusion or mental incompetence were similar, emphasizing the poisoning dangers that older adult populations may face.

While most cases were managed at home with minimal symptoms, 22.1% of those presenting to the emergency department were admitted to the hospital. This admission rate is significantly higher than seen in prior publications of pediatric exposure [20,21]. Major effects were reported in 1% of our cases, highlighting a similar incidence in older adults compared to 1.2% of aggregated cases reported by Banner et al. [22]. All deaths had respiratory failure as indicated by tachypnea, dyspnea, respiratory depression, and/or respiratory arrest. No death cases in older adults had reported lethargy, consistent with prior reports in adult deaths [22]. These results suggest aspiration and/or respiratory compromise as the cause of death. Similar to prior publications, we found that ingestion is the primary route resulting in death [22].

Though this study includes a robust number of patients, there are limitations in the data. Due to the nature of NPDS data, voluntary reporting to poison control centers and loss to follow-up are vulnerabilities of this study that may influence some of the findings discussed. Clinical scenarios prior to exposure were only reported in 15% of cases, limiting the conclusion that confusion or mental incompetence played a role in older adult exposure. Additionally, variables collected by NPDS are subjectively classified by the poison control specialists, particularly the severity of various outcomes. In this

evaluation, only 13 cases were classified as major effects, though 38 cases were admitted to the critical care unit and seven died.

SUDS exposures are increasing among the older adult population despite industry changes such as opaque packaging, child-resistant lids, and bittering agents. The high proportion of unintentional exposures reveals the poisoning dangers for older adult patients with dementia and illuminates the need to safeguard household products. With regards to managing SUDS exposures in the older adult, healthcare providers need to closely monitor for respiratory compromise.

Conclusions

The results of our study indicate that there is an increasing risk of exposure in older adults to laundry pods.

Disclosure statement

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ORCID

Kim Aldy http://orcid.org/0000-0002-3198-2321
Brett Roth http://orcid.org/0000-0002-0154-5999
Dazhe James Cao http://orcid.org/0000-0003-2775-8527

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