Detergent Pod-Related Oral-aerodigestive/ocular Injuries in Children, Ages >0 to <18 years

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ABSTRACT

Purpose Detergent pod-related aerodigestive/ocular chemical burns/ingestion poisoning injuries are a group of injuries of concern to parents/guardians of young children as well as oral healthcare professionals. Each year detergent pod injuries result in thousands of emergency department (ED) visits and significant oral, eye, airway, and digestive trauma. The purpose of this study was to investigate trends in detergent pod injuries resulting in ED visits in children ages >0 to <18 years from 2016-2020.

Methods This cross-sectional study used data collected from the National Electronic Injury Surveillance System (NEISS). A secondary data analysis was performed on the NEISS data from 2016-2020 for children ages >0 to <18 years. Injuries were identified as detergent pod-related oral-aerodigestive/ingestion poisonings, detergent pod-related ocular injuries, or other product-related injuries among children. Time trends and demographic characteristics were analysed by age, sex, and race.

Results There were an estimated 13,176 detergent pod-related oral-aerodigestive injuries/ingestion poisonings and 8,654 detergent pod-related ocular injuries with ED visits during 2016 - 2020. In adjusted logistic regression, white children were more likely to have oral-aerodigestive injuries/ingestion poisonings than black children (p=0.0006). Time trend (p=0.4358), and sex (p=0.3905) failed to reach significance. Children, ages 5 to<18 years, were less likely to have ED visits for oral-aerodigestive injuries/ingestion poisonings, or any detergent pod-related injury than younger children. Children, ages 3 to ≤5 years, were more likely to have detergent pod-related ocular injuries than younger or older children.

Conclusion Time trends for detergent-pod related injuries requiring ED visits remained unchanged from 2016-2020 for oral-aerodigestive injuries/ingestion poisonings. Given the significant health risks associated with detergent pods and the fact that the injuries have not declined, there is a need for improved parent/guardian education and practices in safeguarding detergent pods from children. Dental hygienists are well positioned to provide anticipatory guidance on this safety issue.

Keywords detergent pod, poisoning, oral-aerodigestive injury; ocular injury, NEISS, emergency department visits

NDHRA Priority area**,** **Population level: Health services** (epidemiology).

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INTRODUCTION

Detergent pods were introduced into the United States in 2010[1-3] as convenient, single-use packets of concentrated liquid detergent. The water-soluble membranes dissolve easily, which is a requirement to be useful in washing machines and dishwashers.[3-4] However, due to the risks of chemical exposure and their high pH (pH=10-12), detergent pods have the potential for harm.[5] Being very alkaline, they are corrosive and damaging to oral and other tissue.[4] When placed into the mouth, the detergent pod membrane dissolves very quickly,[2,5] causing chemical burns of the oral tissue and rapid edema resulting in the possibility of upper airway blockage, lung damage, esophageal perforation, necrosis of the tracheobronchial tree, mediastinitis and death.[4] Detergent pods that burst caused 480 ocular injuries in 2015[6]; approximately 35, 150 ingestion injuries from 2012-2017[7]; and required hospitalization in 12.5% of the detergent pod injuries from 2012-2014.[3]

Brightly colored detergent pods resemble attractive candy to young children.[8] In 2015, the ASTM International (formerly the American Society of Testing Materials) recommended standard F3159-15, that the detergent pod outer membrane have an unpleasant fragrance, could withstand minimum compression, would not dissolve immediately; and that the container's packaging be opaque and childproof.[9] The ASTM committee consists of 1000 participants including industry, consumer groups, and government. Additionally, in the United States (US) there are federal statutes that regulate detergents under the Federal Hazardous Substance Act, Consumer Protection Safety Act, and the Poison Prevention Packaging Act. Regulations were initiated in 2015 to help prevent the injuries.[10] Although many manufacturers have complied with the standards introduced by the ASTM and follow the law, detergent pod exposures continue to be frequent and the resulting injuries in children are still unacceptably high.[7]

Oral health care professionals are charged with community engagement and patient education/ anticipatory guidance to improve systemic and oral health. In addition to in-office oral hygiene instructions, dental professionals routinely provide diet counselling (particularly refined carbohydrates); screenings for blood pressure, depression, obstructive sleep apnea, tobacco use, anorexia, and safety at home (child/elder abuse, intimate partner violence); and discussions about safe practices to prevent injuries such as seat belt use, mouthguard use, helmet use, drugs/ alcohol, and poisoning. Oral health care professionals, particularly dental hygienists, have the unique opportunity to speak with parents and children about a wide range of health topics during relatively long, routine care appointments.

Additionally, oral health care professionals provide community health education programs with anticipatory guidance to specific target groups. These presentations often include addressing the risks associated with accidental or intentional poisonings/ injuries from drugs or other substance misuse such as with bath salts, the sniffing of volatile products, and recently the need to address the detergent pod social media "challenge" to swallow detergent pods. For parents of young children, the presentations could also address accidental swallowing or puncturing of detergent pods. It is important for oral health care professionals to have current knowledge and facts for such presentations. Detailed approaches to anticipatory guidance with detergent pods are provided in Appendix 1. The purpose of this study was to determine existing trends in detergent pod-related injuries among children, ages >0 to <18 years, specifically oral-aerodigestive injuries/ingestion poisonings resulting in emergency department (ED) visits from 2016-2020. The results of this study will help inform presentations to patients and groups about the dangers of detergent pod injuries.

METHODS

Study Design/Data Source

This study received acknowledgement as non-human subject research by the West Virginia University Institutional Review Board. A cross-sectional design

was implemented using data from the National Electronic Surveillance System (NEISS). A secondary data analysis was performed on the NEISS data from 2016-2020. The NEISS surveys have been conducted for >45 years by the Consumer Product Safety Commission (CPSC). In 2000, the CPSC included data on all injuries for the Centers for Disease Control and Prevention (CDC).[11] The NEISS survey design has a sampling frame of children's hospitals, and general hospitals of varying sizes, excluding psychiatric hospitals, penal hospitals, or hospitals with ≤ 6 beds.[11]

The number of cases in the data set is the true count of collected data from the reporting hospitals. Depending upon the query, the number of cases and estimates may differ from published CPSC reports when other factors or information is considered.[12] The NEISS caveat is that when working with the data, unweighted values (true counts) <20, or weighted values <1,200, or coefficient of variance >33% provide unstable calculated results and should be used with caution.

Variables

For this study, the outcome variable was detergent pod-related injuries resulting in ED visits (yes: related to oral-aerodigestive injury/ingestion poisoning/related to ocular injuries; and no: other product-related ED visit). All narratives associated with NEISS injury code 949 (detergents) were read and reviewed for identification whether the injury was related to a detergent pod. Words included "pod," "pac," "pack," "capsule," and "ball".[13] Injuries were categorized into detergent pod-related oral-aerodigestive injuries/ingestion poisonings, detergent pod-related ocular injuries, or other product related injuries.

The primary independent variable was "year" to determine differences in detergent pod-related injuries over time among children. The years included were 2016, 2017, 2018, 2019, and 2020. The following variables were investigated: sex (male, female); age (0 to <3 years, 3 to ≤5 years, >5 to <18 years); location (home, other); and race (White, Black, other). Although NEISS ED reports included options for Asian, American Indian/Alaska Native, and Native Hawaiian/Pacific Islanders, the sample sizes for these individual racial/ethnic groups were too small to conduct robust analysis; therefore, the sample was categorized into three groups (Black children, White children, and other children). Hospitalization was dichotomized to yes (treated with admission, treated with transfer, observation, died in facility, or dead on arrival) and no (treated and released, not seen, questionable). These definitions have been used in previous research.[3] The NEISS data set is a limited data set and does not contain other variables which would have been of interest (for example, education, income, and healthcare coverage).

Statistical Analysis

Data analyses included descriptive statistics presented as frequencies and percentages. A Rao-Scott chi-square analysis was conducted to test associations between detergent pod-related oral-aerodigestive injuries/ingestion poisoning and ocular injuries. Logistic regression analyses were conducted to compare associations for the entire sample, subsamples by year, and trend over 5-years. Three types of logistic regression analyses were completed in unadjusted and adjusted logistic regressions: 1) injuries/ingestion poisonings vs. combined ocular and other detergent pod injuries; 2) detergent pod-related ocular injuries vs. combined aerodigestive injuries/ingestion poisonings; 3) other detergent pod injuries; and any detergent pod-related injury vs. combined aerodigestive injuries/ingestion poisonings and ocular injuries. Sex, race, location, and age were included in the adjusted analyses.

Data from NEISS provides cluster, strata, and weights for data analyses which were used to account for the survey design. Weights provided by NEISS were ratio-adjusted in the 5-year logistic regression analyses[14,15] where 2016 to 2020 weights were multiplied by 0.212; 0.218; 0.207; 0.200; and 0.163, respectively; however, they were not ratio-adjusted in the year variable for frequency. All analyses were conducted in a statistical software program (SAS, version 9.4; SAS Institute Inc. Cary, NC, USA).

RESULTS

Table I presents the 5-year combined data (years 2016-2020) comparing ED visits for detergent pod-related oral-aerodigestive injuries/ingestion poisonings, detergent pod-related ocular injuries, and other product-related injuries. An estimated (weighted) 13,176 oral-aerodigestive injuries/ingestion poisonings, 8,654 ocular injuries, and 21,145,073 other product-related injuries resulted in ED visits over the 5 years for children ages >0 to <18 years. The primary independent variable, year, was not statistically significantly associated with ED visits from detergent pod-related oral-aerodigestive injuries/ingestion poisonings, detergent pod ocular injuries, and all other product-related injuries ($p = 0.0558$).

Males and females were also not significantly different in ED visits from detergent pod-related oral-aerodigestive injuries/ingestion poisonings, ocular injuries, and all other product-related injuries ($p = 0.0847$). However, race, age, physical location of the injury, and need for hospital admission were significantly different among the injury types.

Table II presents the logistic regression analyses associated with subsets of ED visits from specific injuries in the 2015-2020 NEISS data. These include 1) a subset only including detergent pod-related oral aerodigestive injuries/ingestion poisonings; 2) a subset only including detergent pod ocular injuries; and 3) a subset only including detergent pod injuries (any type).

For detergent pod-related oral-*aerodigestive injuries/ingestion poisonings* resulting in ED visits, the variable of interest, year, was similar among all years compared with year 2020 ($p = 0.4358$ in adjusted analysis). Sex also failed to reach significance in the adjusted analysis for oral-aerodigestive injuries/ingestion poisoning. However, race was significantly associated with ED visits for oral-aerodigestive injuries/ingestion poisonings for Black children compared with White children, (adjusted odds ratio [AOR] 0.45, 95% CI: 0.29, 0.70; $p = 0.0006$) but not for other race/ethnicity compared with White children (AOR 0.83, 95%CI:0.46,1.51; $p = 0.5416$). Age was also significantly associated with ED visits for oral-aerodigestive injuries/ingestion poisonings. Children, ages 0-2 years, were over 28 times as likely to have ED visit for an oral-aerodigestive injury as children age >5 to <18 years (AOR 28.58, 95% CI: 12.24, 66.73; $p < 0.0001$). Children, ages 3 to ≤ 5 years, were 18 times as likely to have an oral-aerodigestive injury/ingestion poisoning as children, ages >5 years (AOR 18.91,95%CI: 8.47, 42.21; $p < 0.0001$).

For detergent pod-related *ocular injuries* resulting in ED visits, year was associated in overall adjusted analysis ($p = 0.0434$). It should be noted that the years 2018 and 2019 were not significantly different from year 2020. Sex and race relationships with detergent pod ocular injuries failed to reach significance. For detergent pod ocular injuries and age, the relationship was significant. Children ages 3 to ≤5 years were over more likely to have an ocular injury as children, ages >5 to <18 years, (AOR 2.20, 95%CI: 1.43, 3.38; $p = 0.0005$).

For the data analysis from the subset of *any detergent pod-related injury* resulting in ED visits, year was not significant ($p = 0.2036$). Sex was not statistically significant. However, race was significantly associated with ED visit for any detergent pod-related injury for Blacks compared to Whites (AOR 0.58, 95% CI: 0.35, 0.96; $p = 0.0357$) but not for other race/ethnicity compared with Whites (AOR 0.88, 95%CI:0.50,1.53 $p = 0.6369$). Age was also significantly associated with ED visits for any type of detergent pod-related injury.

Appendix 2 (supplemental tables I-III) provide results of additional analyses of the data. In the supplemental tables, NEISS data are stratified by year, age, and sex. It should be noted that due to the sample size, (unweighted values/true counts <20, or weighted values <1,200, or coefficient of variance >33%) some of the cells were suppressed and as a result some calculations could not be determined.

DISCUSSION

In this study of NEISS, 2016-2020 data, there was no change in rate of detergent pod-related injuries

Table I. Five-year detergent pod-related oral-aerodigestive injuries/ingestion poisoning and ocular injuries resulting in emergency department visits 2016-20, ages >0 to <18*

	Detergent Pod Oral-aerodigestive/Ingestion Poisoning Injuries			Detergent Pod Ocular injuries			Other product-related injuries			*p*-value
	n	Weighted n	%	n	Weighted n	%	n	Weighted n	%	
Total	512	13,176	0.06	373	8,654	0.04	762,028	21,145,073	99.90	
Year										0.0558
2016	126	3,930	0.08	66	1,581	0.03	163,155	4,773,818	99.88	
2017	104	2,842	0.06	76	1,615	0.03	168,742	4,795,269	99.91	
2018	91	2,329	0.05	74	1,678	0.04	153,272	4,374,073	99.91	
2019	94	2,175	0.05	77	1,915	0.05	152,266	4,213,104	99.90	
2020	97	1.900	0.06	80	1,865	0.06	124,593	2,988,809	99.87	
Sex										0.0847
Male	278	7,454	0.06	183	4,529	0.04	450,329	12,495,173	99.90	
Female	234	5,722	0.07	191	4,206	0.05	311,692	8,649,609	99.89	
Race										0.0280
White	154	5,301	0.06	128	3,124	0.03	309,664	9,394,108	99.91	
Black	131	1,713	0.07	110	1,814	0.07	137,535	2,528,031	99.86	
Other	57	1,082	0.08	31	655**	0.05	66,346	1,388,145	99.88	
Missing	170	5,080	0.06	105	3,142	0.04	248,483	17,834,789	99.90	
Age (in years)										<.0001
0 to <3	403	10,236	0.24	138	2,950	0.07	170,803	4,221,003	99.69	
3 to <5	91	2,599	0.11	142	2,994	0.12	95, 049	2,423,042	99.77	
≥ 5 to <18	18	340**	0.002	94	2,791	0.02	496,176	14,501,029	99.98	
Location of injury										<.0001
Home	408	11,155	0.13	277	6,626	0.08	281,687	8,460,780	99.79	
Other than home	13**	405**	0.006	cs	166**	0.002	254,319	7,428,911	99.99	
Not Recorded	91	1,616	0.03	90	1,944	0.04	226,022	5,255,383	99.93	
Hospital admissions										0.0004
Yes	69	1,146	0.16	cs	123**	0.02	34,776	734,030	99.83	
No	443	12,029	0.06	371	8,612	0.04	727,252	20,411,043	99.90	

*Note: *p*-values are for the combined 2016-2020 data for oral-aerodigestive/ingestion poisoning injuries; ocular injuries; and all other injuries reporting to the emergency department

Abbreviations: cs, cell suppressed due to small cell size; nc, not calculated.

**Caveat: The unweighted values <20 and weighted values <1,200 are unstable and calculated results should be considered with caution.

Table II. Logistic regression analyses on detergent pod injuries resulting in emergency department visits, NEISS, 2016-2020, ages >0 to <18*

	Oral-aerodigestive/Ingestion Poisoning Injuries[a]			Ocular Injuries[b]			Any detergent pod injury[c]		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Unadjusted Analysis									
Year			0.6009			0.0510			0.4144
2016	1.28	0.69, 2.35	0.4280	0.42	0.23, 0.79	0.0077	0.74	0.41, 1.36	0.3305
2017	0.88	0.52, 1.48	0.6316	0.46	0.26, 0.81	0.0079	0.57	0.32, 1.01	0.0550
2018	0.85	0.49, 1.45	0.5360	0.58	0.27, 1.27	0.1718	0.62	0.31, 1.28	0.1967
2019	0.85	0.47, 1.53	0.5842	0/74	0.48, 1.16	0.1893	0.73	0.45, 1.18	0.1928
2020	Reference			Reference			Reference		
Sex									
Male	1.77	1.37, 2.28	<0.0001	1.31	0.93, 1.84	0.1238	1.65	1.30, 2.09	<0.0001
Female	Reference			Reference			Reference		
Race			0.0001			0.9067			0.0134
White	Reference			Reference			Reference		
Black	0.48	0.30, 0.76	0.0022	0.83	0.42, 1.66	0.5992	0.59	0.38, 0.92	0.0214
Other	1.52	0.86, 2.67	0.6344	1.10	0.61, 1.99	0.9739	1.40	0.84, 2.34	0.1978
Age			<0.0001			<0.0001			<0.0001
0-2 years	27.3	11.74, 63.51	<0.0001	0.60	0.40, 0.90	<0.0001	3.69	2.59, 5.76	<0.0001
3-5 years	18.1	8.12, 40.40	<0.0001	2.24	1.45, 3.44	<0.0001	5.91	4.05, 8.63	<0.0001
6-18 years	Reference			Reference			Reference		
Adjusted Analysis									
Year			0.4358			0.0434			0.2036
2016	1.19	0.65, 2.18	0.5632	0.45	0.25, 0.82	0.0098	0.69	0.40, 1.21	0.1927
2017	0.77	0.45, 1.33	0.3418	0.45	0.25, 0.79	0.0065	0.49	0.28, 0.87	0.0159
2018	0.75	0.47, 1.22	0.2447	0.58	0.26, 1.28	0.1750	0.56	0.29, 1.10	0.0902
2019	0.71	0.40, 1.28	0.2575	0.89	0.50, 1.27	0.3351	0.65	0.40, 1.08	0.0945
2020	Reference			Reference			Reference		
Sex									
Male	1.13	0.86, 147	0.3905	1.06	0.73, 1.53	0.7731	1.15	0.89,1.50	0.2842
Female	Reference			Reference			Reference		
Race			0.0002			0.8301			0.0303
White	Reference			Reference			Reference		
Black	0.45	0.29, 0.70	0.0006	0.98	0.45, 2.11	0.9679	0.58	0.35, 0.96	0.0357
Other	0.83	0.46, 1.51	0.5416	1.02	0.54, 1.92	0.9483	0.88	0.50, 1.53	0.6369
Age			<0.0001			<0.0001			<0.0001
0-2 years	28.58	12.24, 66.73	<0.0001	0.59	0.40, 0.87	0.0085	3.94	2.59,5.99	<0.0001
3-5 years	18.91	8.47, 42.21	<0.0001	2.20	1.43, 3.38	0.0005	6.12	4.13,9.06	<0.0001
6-18 years	Reference			Reference			Reference		

*[a] results are from analyses of ED visits from oral-aerodigestive/ingestion poisoning injuries from detergent pods vs. ocular and other pod injuries

[b] results are from analyses of ED visits from ocular injuries from detergent pods vs. oral-aerodigestive/ingestion poisoning and other pod injuries.

[c] results are from analyses of ED visits from other detergent pod injuries vs. oral-aerodigestive/ingestion poisoning injuries and ocular injuries.

Adjusted odds ratios include sex, race, location, year, and age.

requiring ED visits among children for oral-aerodigestive injuries/ingestion poisonings, and any detergent pod injury by year. Ocular injuries had an overall slight decrease, however 2018 and 2019 were not significantly different from 2020. There are few studies on detergent pod-related injuries requiring ED visits with which to compare the trend results of this study. There were no differences in injuries by sex in this study for detergent pod-related oral-aerodigestive injuries/ingestion poisonings, ocular injuries, or any body part injuries. There are no studies to compare detergent pod aerodigestive injuries/ingestion poisonings. There was one study of ocular injuries due to detergent pods, and the results stratified by sex were similar to the results of this study.[6]

Black children were less likely to have detergent pod-related oral-aerodigestive injuries/ingestion poisonings and injuries in any body part compared with White children, while ocular injuries were not significantly different. Potential explanations for the differences may include preferences in detergent type in which Black adults were less likely to choose detergent pods. Financial considerations drive many decisions, and brand preference for cleaner type (liquid, powder, pod) is often a choice made of habit. Other possibilities for more detergent pod-related oral-aerodigestive injuries/ingestion poisonings among White children include purchases due to targeted product endorsements in the media. White children may be more likely to be present while laundry is being done or the dishwasher is being used. Also, there could be less awareness of detergent pod hazards amongst this group. Since the time frame of the study included the COVID-19 pandemic and people were at home for longer periods of time, it may be possible that more laundry was being done at home with detergent pods than in public laundromats.

By age, there were more detergent pod-related oral-aerodigestive injuries/ingestion poisonings, ocular injuries, and injuries to any body part in children, ages 3 to ≤5 years, as compared with children, ages >5 to <18 years. Children, ages 0 to ≤3 years were also more likely to have an oral-aerodigestive injury than children, ages > 5 to <18 years. The results for age and detergent pod-related oral-aerodigestive injuries/ingestion poisonings are similar to previous studies. For example, researchers of 804 exposures to detergent pods in California children reported that the median age was 2 years for ingestion of detergent pods.[16] In another study of 131 cases related to detergent pods and requiring hospital care, the researchers of that study found ingestion injuries were the most common among children with a median age of 1.4 years.[17] Researchers in another study reported detergent pod-related ocular burns were more common among patients, ages 2-5 years, compared to younger children.[18] A review of 122 publications relevant to detergent pod ingestion and ocular exposure however, reported ingestion to be the most common (>85%), but produced no or only minor issues whereas ocular exposure resulting in injury was found to be less common and infrequent.[13]

Strengths and limitations

This research is based upon national data which is considered a study strength. Weights were ratio-adjusted in the 5-year logistic regression analysis. However, the types of information collected for the NEISS were not being collected specifically for research purposes. It should be noted that maturation of the study participants may have influenced the internal validity of the study results. It is likely that injuries associated with age are the result of older children being aware of the dangers of detergent pods and understanding that detergent pods are not candy, despite their candy-like appearance. Younger children may be more tempted to reach for the pods and be attracted by the pod's colors and appearance and may actually think that these detergent pods are candy.

CONCLUSIONS

There was no decrease in the number of detergent pod-related injuries requiring ED visits among children for oral-aerodigestive injuries/ingestion poisonings, and any related detergent pod injury based on data from 2016-2020. The incidence of ocular injuries remained stable from 2018-2020. Detergent pod-related injuries remain a public health issue. Oral

health care professionals can help prevent detergent pod-related injuries by educating parents/guardians about the dangers of these products.

DISCLOSURES

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REFERENCES

1. Beuhler MC, Henretig FM, Gala P, et al. Health hazards associated with laundry detergent pods—United States, May-June 2012. MMWR. 2012 Oct;61(41):825-9.
2. Gray ME, West CE. Corneal injuries from liquid detergent pods. J AAPOS. 2014 Oct;18(5):494-5.
3. Swain TA, McGwin G, Griffin R. Laundry pod and non-pod detergent related emergency department visits occurring in children in the USA. Inj Prev. 2016 Dec;22(6):396-9.
4. El Bahri, L. Keeping tabs on laundry detergent pod toxicity. Inflammation. 2014 Jun;13(15):16.
5. Gulamhusein H, Sabri K. Detergent pods and children: a health hazard on the rise. CJEM. 2021Jan;23(1):137-8.
6. Haring RS, Sheffield ID, Frattaroli S. Detergent pod–related ocular injuries among preschool-aged children. JAMA Ophthalmol. 2017 Mar 1;135(3):283-4.
7. Gaw CE, Spiller HA, Casavant MJ, et al. Safety interventions and liquid laundry detergent packet exposures. J Pediatr. 2019;144(1):e20183117.
8. Sjogren PP, Skarda DE, Park AH. Upper aerodigestive injuries from detergent ingestion in children. Laryngoscope. 2017 Feb;127(2):509-12.
9. Reynolds KM, Burnham RI, Delva-Clark H, et al. Impact of product safety changes on accidental exposures to liquid laundry packets in children. Clin Toxicol. 2021 May;59(5):392-9.
10. Detergent PACS Act of 2015 HR 1139, 114th Congress [Internet]. Washington DC: Library of Congress; 2022 [cited 12 October 2022]. Available from: https://www.congress.gov/bill/114th-congress/house-bill/1139/all-info?r=45&s=1
11. NEISS. National Electronic Injury Surveillance System [Internet]. Bethesda (MD): United States Consumer Product Safety Commission; 2020 [cited 2022 June 15]. Available from: https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.
12. CPSC. Explanation of NEISS estimates obtained through the CPSC website [Internet]. Bethesda (MD): Consumer Product Safety Commission; 2022 [cited 2022 June 15]. Available from: https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data/Explanation-Of-NEISS-Estimates-Obtained-Through-The-CPSC-Website.
13. Day R, Bradberry SM, Thomas SH, et al. Liquid laundry detergent capsules (PODS): a review of their composition and mechanisms of toxicity, and of the circumstances, routes, features, and management of exposure. Clin Toxicol. 2019 Nov;57(11):1053-63.
14. Waterman BR, Owens BD, Davey S, et al. The epidemiology of ankle sprains in the United States. J Bone Joint Surg Am. 2010 Oct 6;92 (13):2279-84.

15. Budnitz DS, Lovegrove MC, Shehab N, et al. Emergency hospitalization for adverse drug events in older Americans. N Engl J Med. 2011 Nov 24;365:2002-12.

16. Huntington S, Heppner J, Vohra R, et al. Serious adverse effects from single-use detergent sacs: Report from a US statewide poison control system. Clin Toxicol. 2014 Mar;52(3):220-5.

17. Stromberg PE, Burt MH, Rose SR, et al. Airway compromise in children exposed to single-use laundry detergent pods: a poison center observational case series. Am J Emerg Med. 2015 Mar;33(3):349-51.

18. Breazzano MP, Day HR, Tanaka S, et al. Prospective analysis of pediatric ocular chemical burns: laundry detergent pods. J AAPOS. 2018 Dec;22(6):426-8.

Appendix 1
Approaches for Anticipatory Guidance with Detergent Pods

While the detergent pod-related injuries requiring an ED visit have stabilized over the previous years, there have been some reports of increase in these injuries during the pandemic with possibly more time spent inside the house.[1] It is important for oral health care providers, as well as other health care providers and public health officials, to be vigilant in public health messaging and accurate reporting of such injuries. For preschool children under age 6 years, the third most common source of poisoning exposure is household cleaning supplies.[2] Oral health care providers should talk with parents/guardians of young children about safety issues and recommend not letting children handle the detergent pods; keeping the detergent pods in their original containers and out of the reach or sight of children; keeping the container closed and dry; not puncturing or taking the packets apart; reading the package warnings and instructions; and, calling Poison Help (800-222-1222) Control immediately if the detergent pod is swallowed, or causes an ocular or other injury.[3]

Anticipatory guidance by dental professionals should also include the following points to parents/guardians about what to do *if a detergent pod is swallowed:*

- *Avoid inducing vomiting*. Vomiting could further expose the tissue to the alkaline.
- *Avoid neutralizing with a weak acid such as vinegar.* Weak acids could result in an exothermic reaction with thermal burns to the tissue.
- *Avoid activated charcoal.* Activated charcoal delays healing.[4]
- *Seek emergency help immediately.*

REFERENCES

1. Haring RS, Sheffield ID, Frattaroli S. Detergent pod–related ocular injuries among preschool-aged children. JAMA Ophthalmol. 2017 Mar;135(3):283-4.

2. CPSC. CPSC and ACC warn of poison dangers with liquid laundry packets. Release number 13-147 [Internet]. Bethesda (MD): Consumer Product Safety Commission; 2022 [cited 29 Aug 2022]. Available from: https://www.cpsc.gov/content/cpsc-and-accc-warn-of-poison-dangers-with-liquid-laundry-packets

3. Valdez AL, Casavant MJ, Spiller HA, et al. Pediatric exposure to laundry detergent pods. Pediatr. 2014;134(6):1127-35.

4. CPSC. Prevent Child Poisonings. Release number 15-100. 2015 [Internet]. Bethesda (MD): Consumer Product Safety Commission; 2022 [cited 29 Aug 2022]. Available from: https://www.cpsc.gov/content/cpsc-joins-global-effort-to-prevent-child-poisonings.

5. El Bahri, L. Keeping tabs on laundry detergent pod toxicity. Inflammation. 2014 Jun;13(15):16.

Appendix 2: Table I. Detergent pod-related oral-aerodigestive injuries/ingestion poisoning and ocular injuries resulting in emergency department visits by year (weighted frequencies)

	2016			2017			2018	
	Oral-aerodigestive/ Ingestion	Ocular	*p*-value	Oral-aerodigestive/ Ingestion	Ocular	*p*-value	Oral-aerodigestive/ Ingestion	Ocular
Sex			.0027			.3859		
Male								
n	79	42		57	36		45	39
Wt n	2,871	1,081		1,502	769*		1,180	1,239
%	0.04	0.01		0.02	0.01		0.02	0.02
Female								
n	48	25		48	45		48	39
Wt n	1,162	516*		1,344	1,043		1,220	709*
%	0.02	0.01		0.02	0.01		0.02	0.01
Race			.8862			.7769		
White								
n	45	25		33	34		30	28
Wt n	1,920	702*		1,222	848*		951*	907*
%	0.03	0.01		0.02	0.01		0.01	0.01
Black								
n	32	18*		27	22		21	20
Wt n	312*	283*		214*	253*		328*	353*
%	0.02	0.02		0.01	0.02		0.02	0.02
Other								
n	12*	cs*		12*	cs*		12*	cs*
Wt n	285*	95*		296*	105*		308*	245*
%	0.03	0.01		0.04	0.01		0.05	0.04
Missing								
n	38	16*		33	21		30	20
Wt n	1,516	516*		1,114	604*		813*	443*
%	0.03	0.01		0.02	0.01		0.02	0.01
Age in years			<.0001			<.0001		
0 to <3								
n	103	26		74	24		74	30
Wt n	3,370	680*		1,878	367*		1,686	643*
%	0.37	0.07		0.20	0.04		0.20	0.07
3 to <5								
n	19*	27		27	27		14*	27
Wt n	520*	401*		876*	543*		540*	625*
%	0.10	0.08		0.17	0.10		0.11	0.13
≥ 5**								
n	cs*	14*		cs*	30		cs*	21
Wt n	143*	516*		92*	902*		175*	681*
%	0.001	0.004		0.0007	0.01		0.001	0.005
Location of injury			<.0001			<.0001		
Home								
n	104	52	0.02%	86	66		75	58
Wt n	3,250	999*		2,333	1,547		2,139	1,412
%	0.05	0.02		0.03	0.02		0.03	0.02
Other than home								
n	cs*	cs*		cs*	cs*		cs*	cs*
Wt n	153*			104*	17*		131*	146*
%	0.004			0.003	0.0004		0.004	0.004
Not Recorded								
n	20	14*		15*	14*		15*	17*
Wt n	629*	593*		409*	247*		130*	390*
%	0.02	0.01		0.01	0.007		0.004	0.01

Appendix 2: Table I (continued). **Detergent pod-related oral-aerodigestive injuries/ingestion poisoning and ocular injuries resulting in emergency department visits by year (weighted frequencies)**

		2019			2020		
	p-value	Oral-aerodigestive/ ingestion	Ocular	*p*-value	Oral-aerodigestive/ ingestion	Ocular	*p*-value
	.2885			.0382			.6137
		42 975* 0.01	40 713* 0.01		58 1,138 0.02%	32 959* 0.02	
		54 1,336 0.02	43 1,555 0.02		39 761* 0.01	50 940* 0.02	
	.0422			.0005			.0207
		22 589* 0.01	23 712* 0.01		25 723* 0.01	27 496* 0.01	
		27 519* 0.03	31 583* 0.03		25 343* 0.03	22 441* 0.03	
		11* 230* 0.06	cs* 125* 0.03		14* 171* 0.04	cs* 102* 0.03	
		36 974 0.02	23 848* 0.02		33 662* 0.02	29 861* 0.02	
	<.0001			<.0001			<.0001
		74 1,847 0.22	33 803* 0.10		78 1,455 0.21	25 458* 0.07	
		18* 318* 0.07	28 685* 0.14		13* 344* .08	33 740* 0.18	
		cs* 146* 0.001	22 780* 0.01		cs* 100* 0.001	24 700* 0.01	
	<.0001			<.0001			nc
		76 2,051 0.03	54 1,584 0.02		69 1,478 0.03	58 1,528 0.03	
		cs* 65* <0.01	cs* 15* <0.01		cs* 61* 0.003	0*	
		17* 195* 0.01	26* 669* 0.02		26* 361* 0.01	24* 371* 0.01	

*The unweighted values <20 and weighted values <1,200 are unstable and calculated results should be considered with caution.

**For a larger sample size, the age groups include adults >18 years.

Weights were not ratio-adjusted for the 5 years for this result—all years were analyzed separately with their associated weights.

p-values include within-year differences oral-aerodigestive injuries/ingestion poisoning; ocular; and all other injuries reporting to the emergency department (Data on other injuries are not presented).

Abbreviations: n: number; Wt n: weighted number; nc: not calculated because at least one table cell has 0 frequency; cs: cell suppressed due to small cell size.

Appendix 2: Table II. 5-year detergent pod-related oral-aerodigestive injuries/ingestion poisoning and ocular injuries resulting in emergency department visits by age, NEISS, 2016-2020

	2016-2020									
	Ages 0 to < 3 years			Ages 3 to <5 years			Ages ≥5 years**			p-value
	n	Weighted n	%	n	Weighted n	%	n	Weighted n	%	
Total Oral-aerodigestive Injuries/Ingestion Poisoning										
	403	10,236	100.00	91	2,599	100.00	24	656	100.00	
Sex										0.7819[1]
Male	217	5,790	56.6	48	1,433	55.1	16*	445*	67.8	
Female	186	4,446	43.4	43	1,167	44.9	cs*	212*	32.2	
Race										0.0584[1]
White	109	4,054	39.6	38	1,041	40.0	cs*	310*	47.2	
Black	197	1,285	12.6	17*	394*	15.2	cs*	38*	5.8	
Other	47	862*	8.4	cs*	211*	4.1	cs*	217*	33.2	
Missing	140	4,036	39.4	28	953*	36.6	cs*	91*	13.8	
Location of injury										0.0245[1]
Home	325	8,557	85.6	71	2,286	88.0	14*	409*	52.3	
Other than home	cs*	234*	2.3	cs*	166*	6.4	cs*	115*	17.6	
Not Recorded	72	1,445	14.1	14	147*	5.7	cs*	132*	20.1	
Year										0.5002[1]
2016	103	3,370	32.9	19	520*	20.0	cs*	143*	21.8	
2017	74	1,878	18.3	27	876*	33.7	cs*	91*	14.0	
2018	74	1,686	16.5	14	540*	20.8	cs*	174*	26.6	
2019	74	1,847	18.0	18	318*	12.2	cs*	146*	22.3	
2020	78	1,455	14.2	13	344*	13.2	cs*	100*	15.3	
Hospital Admissions										0.1908
Yes	59	936*	9.14	cs*	2018	7.73	cs*	185*	28.16	
No	344	9,301	90.86	83	2,398	92.27	19*	471*	71.84	

Total Ocular injuries										
	138	2,950	100.00	142	2,994	100.00	11	3,578	100.00	
Sex										0.5422[2]
Male	66	1,640	55.6	80	1,582	52.8	43	1,537	43.0	
Female	72	1,310	44.4	62	1,412	47.2	68	2,041	57.0	
Race										0.8761[2]
White	44	988*	33.5	56	1,218	40.7	37	1,460	40.8	
Black	47	650*	22.0	30	455*	15.2	36	809*	22.6	
Other	12*	206*	7.0	13*	264*	8.8	cs*	200*	5.6	
Missing	35	1,106	37.5	43	1,056	35.3	31	1,109	31.0	
Location of injury										0.1152[2]
Home	106	2,019	68.4	104	2,395	80.0	78	2,655	74.2	
Other than home	cs*	141*	4.8	cs*	19*	0.6	cs*	22*	0.6	
Not Recorded	30	790*	26.8	34	580*	19.4	31	900*	25.2	
Year										0.5432[2]
2016	26	680*	23.0	27	401*	13.4	14*	515*	14.7	
2017	24	367*	12.4	27	543*	18.1	30	902*	25.8	
2018	30	643*	21.8	27	625*	20.9	21	681*	19.5	
2019	33	803*	27.2	28	685*	22.9	21	699*	20.0	
2020	25	458*	15.5	33	740*	24.7	24	700*	20.0	
Hospital Admissions										nc
Yes	cs*	67*	2.66	cs*	56*	1.88	0*	—	—	
No	136	2,884	97.74	141	2,938	98.12	111	3,579	100.00	

Abbreviations: n: number; cs: cell suppressed due to small cell size; nc: not calculated.

*The unweighted values <20 and weighted values <1,200 are unstable calculated results should be considered with caution.

**For a larger sample size, the age groups include adults >18 years.

Weights were not ratio-adjusted for the 5 years for this result—all years were analyzed separately with their associated weights.

[1]*p*-values are for the combined 2016-2020 data limited to only detergent-pod related oral-aerodigestive injuries/ingestion poisoning injuries reporting to the emergency department.

[2]*p*-values are for the combined 2016-2020 data limited to only detergent-pod related ocular injuries reporting to the emergency department.

Appendix 2: Table III. Five-year detergent pod-related oral-aerodigestive injuries/ingestion poisonings and ocular injuries resulting in emergency department visits by sex, NEISS, 2016-2020

	Male			Female			*p*-value
	n	Weighted n	%	n	Weighted n	%	
Total Oral-aerodigestive Injuries/Ingestion Poisoning							
	281	7,667	100.00	237	5,824	100.00	
Race							0.8368[1]
White	83	2,995	39.1	72	2,410	41.4	
Black	71	950*	12.4	61	768*	13.2	
Other	34	843*	11.0	27	447*	7.7	
Missing	93	2,880	37.6	77	2,200	37.8	
Age in years**							0.7819[1]
0 to <3	217	5,790	75.5	186	4,446	76.3	
3 to <5	48	1,433	18.7	43	1,167*	20.0	
≥ 5	16*	445*	5.8	cs*	212*	3.6	
Location of injury							0.5143[1]
Home	228	6,518	85.0	183	4,734	81.3	
Other than home	cs*	335*	4.4	cs*	180*	3.1	
Not Recorded	44	814*	10.6	49	919*	15.6	
Year							0.0139
2016	79	2,871	37.4	48	1,162*	20.0	
2017	57	1,502	19.6	48	1,344	23.1	
2018	45	1,180	15.4	48	1,220	21.0	
2019	42	975*	12.7	54	1,336	22.9	
2020	58	1,138*	14.8	39	761*	13.1	
Unassigned weighed n**		1			1`		
Hospital Admissions							0.3633
Yes	42	806*	10.52	30	515*	8.84	
No	239	6,861	89.48	207	5,310	91.16	

Appendix 2: Table III (continued)**. Five-year detergent pod-related oral-aerodigestive injuries/ingestion poisonings and ocular injuries resulting in emergency department visits by sex, NEISS, 2016-2020**

	Male			Female			*p*-value
	n	Weighted n	%	n	Weighted n	%	
Total Ocular injuries							
	189	4,760	100.00	202	4,763	100.00	
Race							0.8870[2]
White	66	1,772	37.2	71	1,894	39.8	
Black	48	1,068*	22.4	65	845*	17.7	
Other	16*	318*	6.7	16	354*	7.4	
Missing	59	1,602	33.7	50	1,669	35.0	
Age in years* **							0.5422[2]
0 to <3	66	1,641	34.5	72	1,309	27.5	
3 to <5	80	1,582	33.2	62	1,412	29.6	
≥ 5	43	1,537	32.3	68	2,041	42.9	
Location of injury							0.3026[2]
Home	141	3,525	74.1	147	3,544	74.4	
Other than home	cs*	151*	3.2	cs*	32*	0.7	
Not Recorded	44	1,084*	22.8	51	1,186	24.9	
Year							0.0228
2016	42	1,080*	22.7	25	516*	11.0	
2017	36	769*	16.2	45	1,042*	22.3	
2018	39	1,239	26.0	40	709*	15.2	
2019	40	713*	15.0	42	1,474	31.5	
2020	32	959*	20.1	50	939*	20.1	
Unassigned weighted n					80		
Hospital Admissions							0.9047
Yes	cs*	67*	1.40	cs*	56*	1.18	
No	187	4,693	98.60	201	4,706	98.82	

Abbreviations: n: number; cs: cell suppressed due to small cell size; nc: not calculated.

*The unweighted values <20 and weighted values <1,200 are unstable and calculated results and should be considered with caution.

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** Weights were not ratio-adjusted for the 5 years for this result—all years were analyzed separately with their associated weights.

[1]*p*-values are for the combined 2016-2020 data limited to only detergent-pod related oral-aerodigestive/ingestion poisoning injuries reporting to the emergency department.

[2]*p*-values are for the combined 2016-2020 data limited to only detergent-pod related ocular injuries reporting to the emergency department.