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Impact of Social Media Challenges on Pediatric Single-Use Detergent Sacs and Diphenhydramine Ingestions Reported to United States Poison Control Centers

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Abstract

Background: Social media platforms are popular among children and often feature challenges that become viral. Notably, the Tide Pod® and Benadryl® challenges encouraged viewers to ingest these substances for their visual appeal and hallucinogenic effects, respectively. This study aimed to assess the clinical impact and outcomes of single-use detergent sacs (SUDS) and diphenhydramine challenges on pediatric ingestions reported to United States (U.S.) Poison Control Centers (PCCs). **Methods**: We conducted a retrospective review of pediatric exposures reported to U.S. PCCs using data from the National Poison Data System (NPDS). The study included intentional single-substance ingestions of both brand-name and generic forms of SUDS and diphenhydramine among children ≤ 19 years. We compared the number of calls, clinical effects, disposition, and management strategies for SUDS (pre: 01/01/17 to 12/31/17 vs. post: 01/01/18 to 12/31/18) and diphenhydramine (pre: 08/01/19 to 07/31/20 vs. post: 08/01/20 to 07/31/21) ingestions 12 months before and after the introduction of the respective social media challenges. Differences in proportions were compared using the Chi-square test. **Results**: During the study period, 469 ingestions of SUDS and 5,702 ingestions of diphenhydramine were reported. Post-challenge periods saw an increase in both SUDS (pre: 82 vs. post: 387; 372% increase) and diphenhydramine ingestions (pre: 2,672 vs. post: 3,030; 13% increase). While there were no significant changes in moderate or major clinical outcomes, hospitalizations increased post-challenge for both SUDS [pre: 4 (4.9%) vs. post: 33 (8.5%); p = 0.25] and

diphenhydramine [pre: n = 904 (33.8%) vs. post: 1,190 (39.3%); p < 0.001]. **Conclusion**: Pediatric ingestions reported to U.S. PCCs and hospitalizations increased coinciding with the introduction of Tide Pod® and Benadryl® challenges. While causality cannot be definitively established, it is essential for pediatricians and parents to be aware of these challenges and educate vulnerable children about the harmful effects of participation in such challenges.

Keywords

Emergency Medicine, Ingestions, Toxicology, Social Media Challenges, Pediatrics

1. Introduction

In today's digital era, social media is integral to the daily lives of children and adolescents, facilitating unprecedented content exchange in the form of posts, videos, photos, and articles. During the widespread lockdowns and social isolation caused by the SARS-CoV-2 pandemic, social media became increasingly vital for children to maintain social connections [1]. According to a 2023 Pew Research Center survey, approximately one in six teenagers in the United States (U.S.) reported nearly constant use of social media platforms [2]. Among these platforms, TikTok™ has gained global popularity, particularly for its viral challenges that encourage or dare viewers to replicate specific activities.

While some challenges are benign, others involve risky behaviors, such as the Tide Pod® challenge and the Benadryl® challenge. The Tide Pod® challenge encouraged participants to bite into single-use detergent sacs (SUDS), which are attractive for their bright colors and texture resembling Jell-O® [3]. As the contents of the package are caustic and under high pressure, adverse effects from such ingestions can include intestinal discomfort, oropharyngeal burns, aspiration, and altered mental status [4].

The Benadryl® challenge involved ingesting supratherapeutic doses of diphenhydramine (the generic formulation of Benadryl®) to induce hallucinogenic effects [5]. Other clinical effects can include an antimuscarinic toxidrome, seizures, wide complex tachydysrhythmias, and death [6]. Consequently, acute care clinicians and toxicologists at U.S. Poison Control Centers (PCCs) encountered an increasing number of pediatric diphenhydramine overdose cases [7], prompting a warning from the U.S. Food and Drug Administration outlining the risks associated with diphenhydramine abuse and misuse linked to the challenge [5].

The impact of these challenges on pediatric ingestions has not been extensively described. Our objective was to characterize the clinical impact and outcomes of the social media challenges on pediatric diphenhydramine and SUDS ingestions reported to U.S. PCCs.

2. Methods

We conducted a retrospective review of pediatric cases involving intentional

ingestions of SUDS and diphenhydramine, utilizing data abstracted from the National Poison Data System (NPDS), which serves as the data repository for all 55 U.S. PCCs. The database was queried for all generic and product codes related to the two reported exposures. Pediatric patients were defined as those aged ≤ 19 years, in line with NPDS nomenclature [8]. Inclusion criteria encompassed intentional single-substance ingestion of both brand name and generic forms of SUDS and diphenhydramine in children aged ≤ 19 years. Non-oral ingestion routes, calls to PCCs for information requests, animal exposures, and ingestions involving more than one substance were excluded. The onset of the SUDS challenge was estimated to be January 1, 2018, corresponding with the initial version of the challenge posted on YouTube™ [9], and corroborated by Google search trends reported by Marshall *et al.* [10]. The onset of the diphenhydramine challenge was approximated to August 1, 2020, coinciding with a health alert issued by Johnson & Johnson regarding inappropriate diphenhydramine use following the death of a teenager [11].

Patient demographics, exposure details, clinical effects, medical outcomes, and therapeutic interventions were abstracted for comparative analysis between the pre-challenge (01/01/17 to 12/31/17 for SUDS) (08/01/19 to 07/31/20 for diphenhydramine) and post-challenge periods (01/01/18 to 12/31/18 for SUDS) (08/01/20 to 07/31/21 for diphenhydramine). Categorical variables were compared using the Chi-square test ($p < 0.05$). The study received Institutional Review Board exemption.

3. Results

3.1. General Characteristics

During the study period, 469 SUDS and 5,702 diphenhydramine ingestions were reported. We observed an increase in both SUDS (pre: 82 vs. post: 387; 372% increase) and diphenhydramine ingestions (pre: 2,672 vs. post: 3,030; 13% increase) during the post-challenge period compared to the pre-challenge period (**Table 1**). There was an increase in mean monthly PCC calls for both SUDS [pre: 6.83 ± 2.4 vs post: 32.2 ± 41.0; $p = 0.04$] and diphenhydramine [pre: 223 ± 24.7 vs. post: 253 ± 31.4; $p = 0.017$] during the post-challenge period. The total number of calls for SUDS and diphenhydramine are depicted in **Figures 1-2**, respectively.

SUDS: Significant post-challenge increases in ingestions were noted among children aged 13 to 19 years [pre: 42 (51.2%) vs. post: 300 (77.5%); $p < 0.01$], males [pre: 36 (43.9%) vs. post: 226 (58.4%); $p = 0.04$], and occurring at school [pre: 4 (4.9%) vs. post: 70 (18.1%); $p = 0.002$]. Cases of abuse also increased post-challenge [pre: 0 (0%) vs. post: 20 (5.2%); $p = 0.27$] (**Table 1**).

Diphenhydramine: Significant post-challenge increases in ingestions were noted among children aged 6 to 12 years [pre: 202 (7.6%) vs. post: 294 (9.7%); $p = 0.007$], females [pre: 1,905 (71.3%) vs. post: 2,326 (76.8%); $p < 0.001$], with the majority of ingestions occurring at home [pre: 2,435 (91.1%) vs. post: 2,879 (95.0%); $p < 0.001$], and of suicidal intent [pre: 1,998 (74.8%) vs. post: 2,475 (81.7%); $p < 0.001$] (**Table 1**).

Table 1. Demographic characteristics, clinical outcomes, and disposition of pediatric SUDS and diphenhydramine ingestions pre- and post-challenge.

Characteristic	SUDS Pre-challenge n = 82 n (%)	SUDS Post-challenge n = 387 n (%)	p-value	Diphenhydramine Pre-challenge n = 2,672 n (%)	Diphenhydramine Post-challenge n = 3,030 n (%)	p-value
Age group, years*			**<0.01**			**0.007**
≤5	1 (1.2)	0 (0.0)		0 (0.0)	2 (0.1)	
6 - 12	39 (47.6)	87 (22.5)		202 (7.6)	294 (9.7)	
13 - 19	42 (51.2)	300 (77.5)		2464 (92.4)	2725 (90.2)	
Sex			**0.04**			**<0.001**
Male	36 (43.9)	226 (58.4)		762 (28.5)	699 (23.0)	
Female	44 (53.7)	149 (38.5)		1905 (71.3)	2326 (76.8)	
Unknown	2 (2.4)	12 (3.1)		5 (0.2)	5 (0.2)	
Reason			0.27			**<0.001**
Abuse[a]	0 (0.0)	20 (5.2)		227 (8.5)	183 (6.0)	
Misuse[b]	63 (76.8)	282 (72.8)		273 (10.2)	213 (7.0)	
Suspected suicide attempt	16 (19.5)	65 (16.8)		1,998 (74.8)	2,475 (81.7)	
Unknown	3 (3.7)	20 (5.2)		174 (6.5)	159 (5.3)	
Exposure Site			**0.002**			**<0.001**
Residence	62 (75.6)	277 (71.6)		2,435 (91.1)	2,879 (95)	
School	4 (4.9)	70 (18.1)		56 (2.1)	21 (0.7)	
Other	16 (19.5)	40 (10.3)		181 (6.8)	130 (4.3)	
Outcome*			0.23			0.087
No effect	13 (15.9)	93 (24.0)		362 (13.6)	373 (12.4)	
Minor effect[d]	62 (75.6)	238 (61.5)		788 (29.8)	968 (32.1)	
Moderate[e]	4 (4.9)	14 (3.6)		1,123 (42.5)	1,207 (40.1)	
Major[f]	3 (3.6)	42 (10.9)		370 (14.0)	462 (15.3)	
Death	0 (0.0)	0 (0.0)		2 (0.1)	3 (0.1)	
Management Site			0.96			**<0.001**
Managed on-site (non-HCF[g])	45 (54.9)	206 (53.2)		156 (5.8)	102 (3.4)	
Managed at HCF	30 (36.6)	146 (37.7)		2,483 (93.0)	2,894 (95.5)	
Unknown	7 (8.5)	35 (9.1)		33 (1.2)	34 (1.1)	
Disposition of patients managed at HCF			0.25			**<0.001**
Hospitalized	4 (4.9)	33 (8.5)		904 (33.8)	1,190 (39.3)	

Continued

Intensive Care Unit	2 (2.4)	2 (0.5)	464 (17.4)	553 (18.3)
Treated and released	24 (29.3)	111 (28.7)	815 (30.5)	821 (27.1)
Other	52 (63.4)	241 (62.3)	489 (18.3)	466 (15.3)

*There were 6 patients with missing data in the pre-challenge period and 9 patients post-challenge in the age category and 27 patients with missing data in the pre-challenge period and 17 patients post-challenge in the outcome category. NPDS definition classifications. a. **Abuse**: intentional improper use to gain a high, euphoric, or psychotropic effect, **b. Misuse**: intentional improper use for reasons other than a psychotropic effect, c. **Suspected suicide attempt**: inappropriate use of a substance for reasons that are suspected to be self-destructive or manipulative. d. **Minor effect:** minimally bothersome and usually resolve rapidly. e. **Moderate effect:** more pronounced, prolonged, or systemic relative to minor effects and involve some form of indicated treatment. f. **Major effect:** life-threatening or result in significant residual disability or disfigurement. g. **HCF:** health care facility.

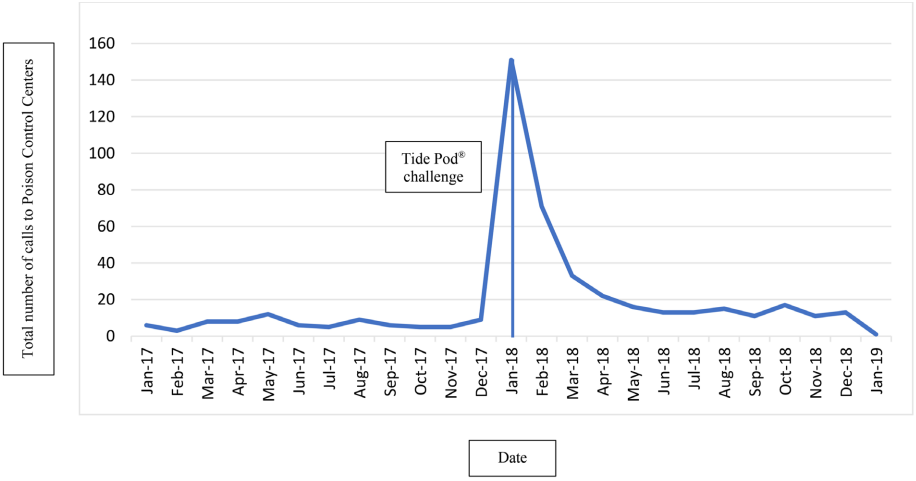

Figure 1. Total number of monthly calls to U.S. PCCs for pediatric SUDS ingestions pre- and post-challenge.

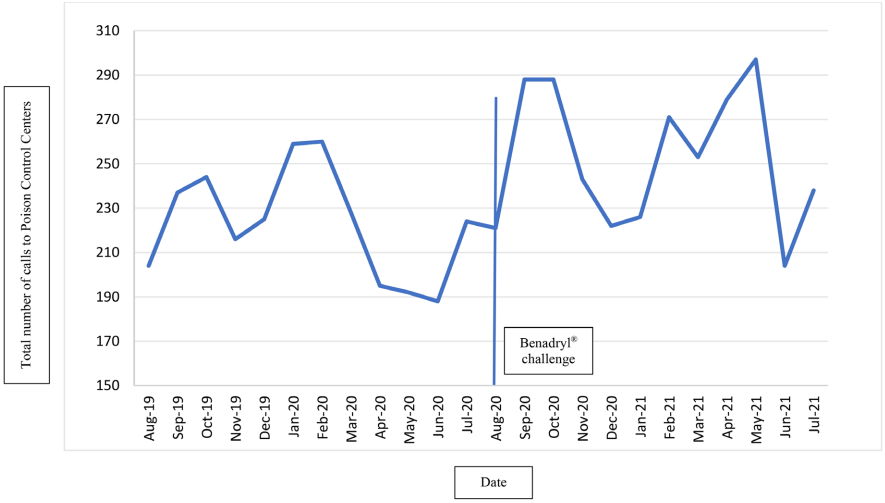

Figure 2. Total number of monthly calls to U.S. PCCs for pediatric diphenhydramine ingestions pre- and post-challenge.

3.2. Medical Outcomes and Disposition

SUDS and Diphenhydramine: Although there were no significant differences in moderate or major clinical outcomes, hospitalizations increased post-challenge for both SUDS [pre: 4 (4.9%) vs. post: 33 (8.5%); p = 0.25] and diphenhydramine ingestions [pre: n = 904 (33.8%) vs. post: 1,190 (39.3%); p < 0.001] (Table 1). There were no changes in the number of deaths pre- and post-challenge (Table 1).

3.3. Clinical Effects and Therapeutic Interventions

During the post-challenge period, clinical symptoms were more frequently observed in both types of ingestions. However, there were no significant differences in therapeutic interventions between the two periods for either SUDS or diphenhydramine ingestions.

SUDS: Gastrointestinal effects were the most common clinical manifestation in both the pre- and post-challenge challenge periods [pre: 30 (36.6%) vs. post: 118 (30.5%); p = 0.281] followed by respiratory effects [pre: 3 (3.7%) vs. post: 6 (1.6%); p = 0.206] (Table 2). The most used therapies were dilution [pre: 53 (64.6%) vs. post: 175 (45.2%); p = 0.001] and food/snack [pre: 5 (6.1%) vs. post: 33 (8.5%); p = 0.464] (Table 3).

Table 2. Clinical effects of pediatric SUDS and diphenhydramine ingestions pre- and post-challenge.

Effect	SUDS Pre-challenge n (%)	SUDS Post-challenge n (%)	p-value	Diphenhydramine Pre-challenge n (%)	Diphenhydramine Post-challenge n (%)	p-value
Any	46 (56.1)	159 (41.1)	**0.013**	1964 (73.5)	2311 (76.3)	**0.016**
Cardiovascular	1 (1.2)	4 (1.0)	0.882	1430 (53.5)	1757 (58.0)	**<0.001**
Neurologic	0	0	N/A	1148 (43.0)	1282 (42.3)	0.618
Ocular	8 (9.8)	21 (5.4)	0.139	450 (16.8)	503 (16.6)	0.808
Gastrointestinal	30 (36.6)	118 (30.5)	0.281	264 (9.9)	337 (11.1)	0.128
Respiratory	3 (3.7)	6 (1.6)	0.206	127 (4.8)	147 (4.9)	0.862
Other	6 (7.3)	6 (1.6)	**0.003**	65 (2.4)	67 (2.2)	0.579

Table 3. Therapeutic interventions for pediatric SUDS and diphenhydramine ingestions pre- and post-challenge.

Treatments	SUDS Pre-challenge n (%)	SUDS Post-challenge n (%)	p-value	Diphenhydramine Pre-Challenge n (%)	Diphenhydramine Post-Challenge n (%)	p-value
Benzodiazepines	0	1 (0.3)	N/A	543 (20.3)	654 (21.6)	0.243
Activated Charcoal	N/A	N/A	N/A	234 (8.8)	299 (9.9)	0.151
Antiemetics	1 (1.2)	10 (2.6)	0.458	69 (2.6)	88 (2.9)	0.458
Sedation	1 (1.2)	0	N/A	64 (2.4)	81 (2.7)	0.506
Oxygen	1 (1.2)	0	N/A	67 (2.5)	80 (2.6)	0.752
Alkalinization	N/A	N/A	N/A	47 (1.8)	68 (2.2)	0.193
Physostigmine	N/A	N/A	N/A	55 (2.1)	52 (1.7)	0.342

Continued

Intubation	1 (1.2)	0	N/A	48 (1.8)	55 (1.8)	0.958
Sodium Bicarbonate	N/A	N/A	N/A	12 (0.4)	19 (0.6)	0.362
Dilution	53 (64.6)	175 (45.2)	0.001	N/A	N/A	N/A
Food/Snack	5 (6.1)	33 (8.5)	0.464	N/A	N/A	N/A
Bronchodilators	0	1 (0.3)	N/A	N/A	N/A	N/A
Steroids	3 (3.7)	0	N/A	N/A	N/A	N/A

Diphenhydramine: Cardiovascular effects were the most common clinical manifestation and increased post-TikTok™ challenge [pre: 1,430 (53.5%) vs. post: 1,757 (58.0%); $p < 0.001$], followed by neurologic [pre: 1,148 (43.0%) vs. post: 1,282 (42.3%); $p = 0.618$], and ocular [pre: 450 (16.8%) vs. post: 503 (16.6%); $p = 0.808$]. (Table 2). The most common treatments utilized were benzodiazepines [pre: 543 (20.3%) vs. post: 654 (21.6%); $p = 0.243$], followed by activated charcoal [pre: 234 (8.8%) vs. post: 299 (9.9%); $p = 0.151$], and antiemetics [pre: 69 (2.6%) vs. post: 88 (2.9%); $p = 0.458$] (Table 3).

4. Discussion

Our study demonstrated an increase in both intentional pediatric ingestions and hospitalizations related to SUDS and diphenhydramine following the associated social media challenges.

These findings are consistent with recent literature that indicates a temporal relationship between spikes in Google™ search trends for ingestion challenges and subsequent reports to U.S. PCCs [10]. However, our study differs from prior research in several respects. Notably, we compared the number of calls to U.S. PCCs 12 months pre- and post-challenge, whereas the previous study by Marshall *et al.* examined only 3 months pre- and post-Google™ search trends [10]. Additionally, while peak Google™ search trends coincided with the start date of the Tide Pod® challenge, they did not align with our start date for the Benadryl® challenge, which began by at least August 2020, as indicated by a health alert from Johnson & Johnson [11].

Our results revealed a notable increase in SUDS ingestions and associated clinical effects, consistent with findings reported by Marshall *et al.* [10]. The spike in monthly calls prior to the official start of the Tide Pod® challenge, as depicted in Figure 1, likely reflects early discussions on platforms like Twitter, which intensified by December 2017 and contributed to the surge in reported cases [9]. Although the increase in hospitalizations was not statistically significant, the observed trend suggests a potential area for further investigation, especially given the overall rise in SUDS ingestions.

While SUDS ingestions increased sharply post-challenge, the trend for diphenhydramine remained relatively stable between pre- and post-challenge periods. Notably, unlike the increase in SUDS ingestions, which were primarily due

to abuse or misuse, the increase in diphenhydramine ingestions was more commonly associated to suicidal intent. This finding may be attributed to heightened mental stress associated with the SARS-CoV-2 pandemic, which coincided with the challenge period [12]. Social isolation during the pandemic could have independently contributed to the increase in suicidal ingestions. Similarly, Marshall *et al.* observed an increase in diphenhydramine ingestions due to suicidal intent, occurring one-to-two months after a peak in abuse/misuse exposures in September 2020 [10]. In a study evaluating diphenhydramine exposures reported to U.S. PCCs between 2007 and 2020, Darracq *et al.* also identified an increase in ingestions due to suicidal intent, consistent with our findings. However, their study focused solely on adolescents aged 13 to 19 years and had limited post-challenge and post-pandemic data [13]. They also reported an increase in cardiac complications, similar to those observed in our study [13].

Interestingly, our study identified an increase in diphenhydramine ingestions among school-aged children, a demographic not prominently highlighted in previous reports [14]. This underscores the potentially harmful effects of unregulated social media use and highlights the vulnerability of younger children to these challenges.

Marshall *et al.* noted the time lag before the spike in suicidal ingestions could provide a window of opportunity for public health intervention and parental education to mitigate the medical and mental health consequences of these challenges [10]. Given the health risks associated with these challenges, parents should supervise their children's exposure to potentially harmful social media content and ensure safe medication storage. Pediatricians can advocate for enhanced parental oversight, content moderation, and accountability from social media platforms. Public health interventions, such as designing SUDS packaging to minimize resemblance to candy and revising safety standards and accessibility of over-the-counter diphenhydramine can also be impactful risk mitigation strategies.

Limitations

This study has several limitations. The reliance on passive, voluntary, and self-reporting to PCCs, and the focus on single-substance exposures may lead to an underestimation of ingestion frequencies. Variations in PCC usage, the lack of standardized call volumes, and the use of approximated challenge start dates may also impact our findings. Additionally, the NPDS database excludes medical examiner data, potentially skewing fatality counts. Lastly, the absence of specific data directly linking ingestions to challenges limits our ability to establish definitive causation. The unexpected increase in suicidal ingestions associated with the diphenhydramine challenge may be influenced by other psychosocial stressors, including underlying mental health conditions and self-harming behaviors. Mandated stay-at-home orders and school closures during the SARS-CoV-2 pandemic likely heightened social media use among children, increasing their exposure to online content [14]. The overlap between the pandemic and the diphenhydramine

challenge complicates the assessment of the pandemic's influence on the intentionality of these ingestions.

5. Conclusion

Pediatric ingestions reported to U.S. PCCs and subsequent hospitalizations increased following the introduction of the Tide Pod® and Benadryl® challenges. While the increase in SUDS ingestions was primarily due to abuse or misuse and likely influenced by social media challenges, the increase in diphenhydramine ingestions was largely associated with suicidal intent and less likely to be due to the challenge itself. Although causality cannot be definitively established, pediatricians and parents should remain vigilant and educate vulnerable children about the harmful effects of participation in such challenges.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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