COVID-19 Lockdown and its Effects on Pediatric Oral Ingestions with Toxic Substances: A Retrospective Study of the Belgian Poison Center Reports

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Keywords

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Abstract

Background:

The COVID-19 lockdown led to significant changes in household behaviors, including an increase in the use of disinfectants, hand sanitizers, and cleaning agents. These changes may have raised the risk of pediatric intoxications. This study examines the impact of lockdown measures on the incidence of the reports of oral exposures to toxic products in children obtained from the Belgian Poison Center.

Methods:

A retrospective analysis was conducted of all pediatric cases of oral ingestion with hand sanitizers, bleach, detergents, or medicines reported to the Belgian Poison Center during the first lockdown (March 1–May 31, 2020) and compared to data from the same period in 2019, 2021, and 2022. Descriptive and comparative statistical analyses were performed to evaluate the frequency, characteristics, and trends in exposure cases.

Results:

A total of 2591 pediatric ingestion cases were reported during the lockdown in 2020, compared to 2657, 2406, and 2644 cases in 2019, 2021, and 2022, respectively. In 2020, the number of calls related to hand sanitizers increased by 329% compared to 2019, with continued elevated numbers in the following years. Bleach and detergent exposure cases also increased by 163% and 30%, respectively, while cases involving human medicines decreased by 20%. Most cases involved young children, with those under six years consistently accounting for over 75% of exposures throughout the study period. During the lockdown, children aged 2–6 years were significantly overrepresented, while adolescent cases were underrepresented. Exposure cases from educational institutions and hospitals decreased and were significantly underrepresented. Referrals to emergency departments decreased slightly during the lockdown, with non-referrals increasing correspondingly.

Conclusion:

The COVID-19 lockdown period saw a marked increase in reports of pediatric oral ingestions to hand sanitizers and household chemicals, highlighting the unintended consequences of public health measures on child safety. These findings underscore the need for targeted public health interventions, including public awareness campaigns and stricter product safety regulations, to mitigate the risk of pediatric poisoning during future public health emergencies.

What is already known on this topic

International studies have reported a surge in poison control center cases linked to cleaning agents and hand sanitizers during the lockdown measures in the early months of the pandemic. However, the specific impact of lockdown measures on acute intoxication trends among children in Belgium has not yet been thoroughly investigated.

What this study adds

The study investigates the impact of the COVID-19 lockdown and Its effects on pediatric oral Ingestions with toxic substances and underscores the need for targeted public health interventions, including public awareness campaigns and stricter product safety regulations, to mitigate the risk of pediatric poisoning during future public health emergencies.

Introduction

The COVID-19 pandemic, which became global in early 2020, brought about unprecedented changes to daily life as governments worldwide implemented different lockdown measures to curb the spread of the virus. In Belgium, the first strict lockdown measures, which began on March 18, 2020, and lasted until May 2020, included strict stay-at-home orders, the closure of schools, catering and non-essential businesses, and restrictions on social interactions (1). While these interventions were deemed vital for public health, they also created significant shifts in household behaviors and routines.

Among these changes was a dramatic increase in the use of disinfectants, bleach, hand sanitizers, and other cleaning agents (2, 3). This surge was driven by widespread fears of transmission of SARS-CoV-2, as in the pandemic's early stages, it was unclear whether the virus spread exclusively through respiratory droplets or also via contaminated surfaces (4). Alongside this, the COVID-19 pandemic also influenced medication use, with a notable trend of global drug stockpiling observed during its early months, particularly in developed countries (5). These behavioral shifts, reinforced by public messaging and individual differences, combined with extended time spent at home, inadvertently heightened the risk of unintentional exposure to hazardous substances, especially in children (6, 7). With children spending more time indoors and driven by their natural curiosity, the likelihood of accidental ingestion increased. Young children are especially vulnerable to accidental exposures, which are a leading cause of poisoning and intoxication incidents in this age group (8).

International studies have reported a surge in poison control center cases linked to cleaning agents and hand sanitizers during the pandemic's early months (9-13). However, the specific impact of lockdown measures on acute poisoning trends among children in Belgium has not been thoroughly investigated. The Belgian Poison Center is a national public service organization available 24/7 to provide advice and assistance in cases of poisoning and toxic exposure. It is dedicated to responding to emergency calls regarding harmful substances, supporting both the public and healthcare professionals; it receives approximately 65,000 calls annually. The Center also documents all cases in detail for administrative and research purposes.

This study aims to assess the oral ingestion cases with hand sanitizers, bleaching agents, detergents, and human medicines in children that have been reported to and documented by the Belgian Poison Center before, during, and after the first lockdown period. By examining the frequency and characteristics of these reported incidents, we seek to highlight the unintended consequences of lockdown measures on child safety and identify opportunities for public health interventions.

Methods

Study design

This retrospective review analyzed all oral ingestion cases in children of (a) hand sanitizers (biocidal products for human hygiene), (b) bleaching products for cleaning, (c) detergents and (d) human medicines that were reported to the National Belgian Poison Center during an equal period before (March 1st , 2019, through May 31st, 2019), during (March 1st , 2020, through May 31st , 2020) and after (March 1st , 2021, through May 31st , 2021 and March 1st , 2022, through of May 31st , 2022) the COVID-19 lockdown.

Data source and data collection

We report on anonymized data that we obtained from the Belgian Poison Center through a formal data request process. This dataset comprises information gathered from exposure calls received between 2019 and 2022. Each call was handled in accordance with internal operating procedures and documented using a standardized data collection form. Exposures were identified using the European Product Categorization System (EuPCS). We included only cases that met following criteria: firstly, we included only cases with oral exposures, excluding other routes such as dermal, ocular, or inhalation. Secondly, the product types included were restricted to biocidal products for human hygiene (hand sanitizers), bleaching products for cleaning, detergents and human medicines, all other product categories were excluded. Finally, only data on children aged 0-18 years were included, as this age group was the target population for our investigation. Subject-identifying information was already removed from the dataset provided by the Belgian Poison Center and was not accessible to investigators. All missing data was removed. As all data that were handled by the researchers consisted of an anonymized data collection without any identifying characteristics, no approval from an Ethics Committee was required. There are no conflicts of interest to declare.

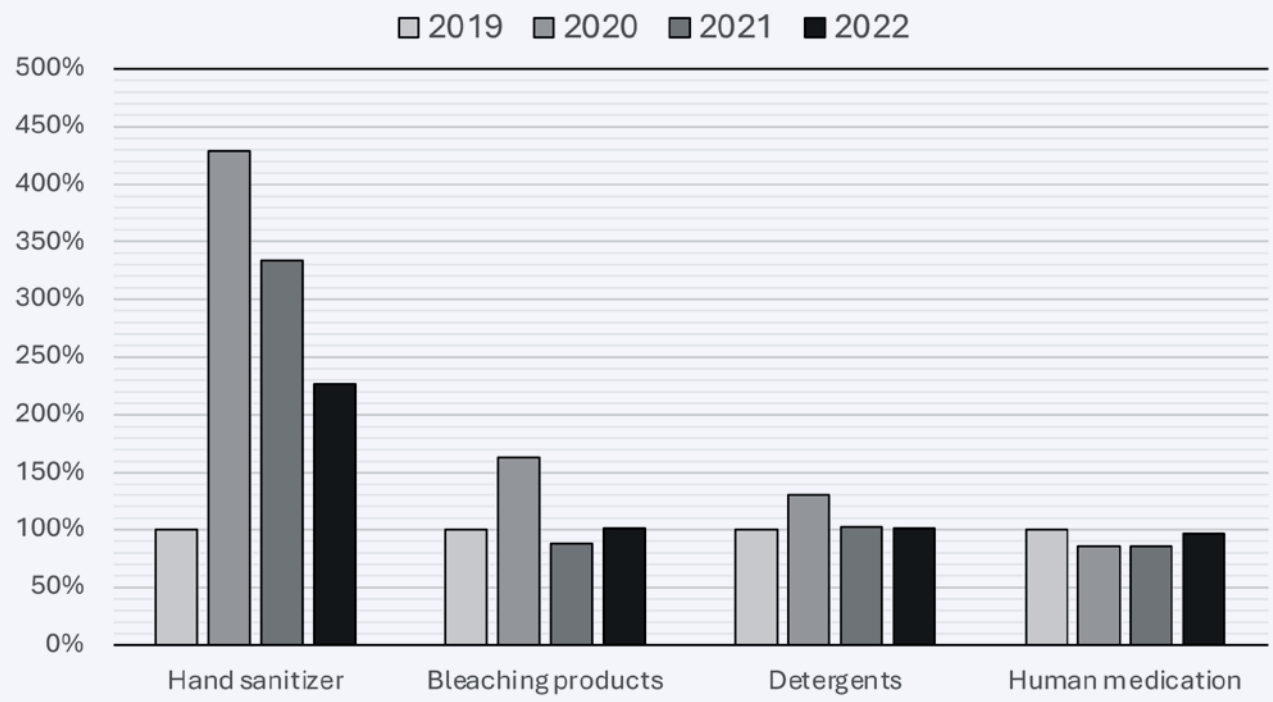
Statistical analysis

The primary objective of this study was to evaluate the number of reports of oral exposure to (a) hand sanitizers, (b) bleaching products for cleaning, (c) detergents and (d) human medicines in children received in the period of lockdown (from the 1st of March 2020, through the 31st of May 2020) and the same period before

TABLE 1: The frequency of calls regarding oral intoxications in children with household cleaning products, hand sanitizers and human medication received in 2019, 2020, 2021 and 2022 (1st March – 31st May).

Product	2019 n	2020 n	2021 n	2022 n
Total	2657	2604	2440	2644
Hand sanitizer	44	189	147	100
Bleaching product	49	80	43	50
Detergent	310	404	320	312
Human medication	2254	1931	1930	2182

FIGURE 1: Year-to-year percentage change (2019-2022).



(2019) and after (2021 and 2022) lockdown. Descriptive statistical analysis was used for all the products identified in the study. We also performed comparative statistical analysis using chi-square tests to determine whether a change in frequencies of cases was statistically significant. A year-to-year percentage change was calculated for each product between 2019 and 2022. The secondary objective of this study was to compare the characteristics of the calls between all periods of interest. We considered the following categorical variables: (i) age group, (ii) victim location and (iii) recommended location of treatment. Comparative statistical analysis was performed using Pearson chi-square tests for categorical variables. When statistically significant ($p < 0.05$), post-hoc analysis using adjusted residuals with a Bonferroni correction was conducted. We used IBM SPSS® Statistics version 29.0 for the data analysis. Ninety-five percent confidence intervals for raw counts and proportions were calculated using a Poisson distribution and using the Clopper-Pearson method.

Results

Frequency of calls for oral ingestions by product type

The Belgian Poison Center received a total of 2591 calls reporting oral exposures with analyzed toxic products in children during the lockdown period in 2020 (1st March – 31st May), whereas 2657, 2406 and 2644 calls were received during the same period in 2019, 2021 and 2022 respectively (Table 1). Of these 2591 calls in 2020, 189 (95% CI, 162.1- 215.9) calls were related to hand sanitizers, 80 (95% CI, 62.5 - 97.5) were related to bleaching products, 404 (95% CI, 364.6 - 443.4) were related to detergents and 1901 (95% CI, 1815.5 - 1986.5) were related to human medication (Table 1). The distribution of cases among the product categories varied significantly across the 4 years ($x2(9, N=10,434) = 176.385$ ($p<0.001$)). During lockdown, when compared to 2019, we observed a percentage increase of 329% for reports of exposure with hand sanitizers. For the number of exposures with bleaching products and detergents we observed a 163% increase and a 30% increase respectively. Whilst for the number of exposures with human medication, we observed a 20% decrease (Figure 1). Additionally, for hand sanitizers we observed a persistent increase in 2021 (+234%) and 2022 (+127%) compared to 2019 (Figure 1).

Monthly trends of reported oral ingestions

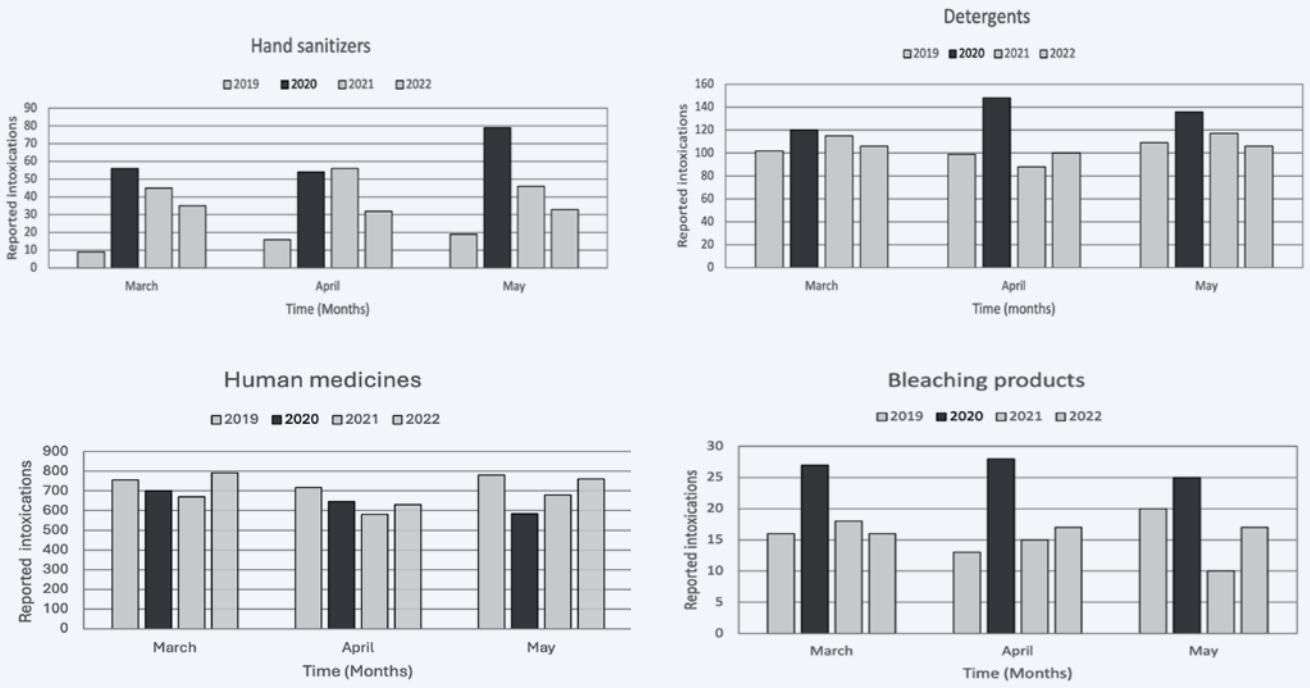
When analyzing the monthly numbers of reported intoxications related to hand sanitizers, during lockdown, we observed 56 reported exposures in March, 54 reports during April and 79 reports during May (Figure 2. Upper left). Compared to 2019, this is an increase of 522%, 238% and 316% for March, April, and May respectively. In 2021 and 2022, we observed a steady decrease in the number of reports compared to 2020 for March with 45 reports (-17%) and 35 reports (-35%) respectively and for May with 46 reports (-42%) and 33 reports (-58%) respectively, while for April we initially observed a slight increase in 2021 with 56 reports (+4%) followed by a considerable decrease in 2022 with 32 reports (-41%).

When we look at the monthly numbers of reported intoxications related to detergents, during lockdown, we observed 120 reported exposures in March, 148 exposures in April and 136 exposures in May (Figure 2. Upper right). Compared to 2019, this is an increase of 18%, 50% and 25% for March, April, and May respectively.

When evaluating the monthly numbers of reported intoxications related to bleaching products, during lockdown, we observed 27 reported exposures in March, 28 exposures in April and 25 exposures in May (Figure 2. Lower right). Compared to 2019, this is an increase of 69%,115% and 25% for March, April, and May respectively. In 2021 and 2022, we observed an important decrease for all 3 months compared to 2020.

Regarding the reported intoxications of human medication, during lockdown, we observed 700 reported exposures in March, 636 exposures in April and 575 exposures in May (Figure 2. Lower left). Compared to 2019, this is a decrease of 12%, 9% and 34% for March, April, and May respectively. In 2021, compared to lockdown we observed a further decrease of reports for March (-4%) and April (-9%), while for May we already observed an increase of reports

FIGURE 2: Monthly numbers of reported oral intoxications in children made to the Belgian poison center regarding household cleaning products, hand sanitizers and human medication in 2019, 2020, 2021 and 2022 (1st March to 31st May).



(+18%). In 2022, we observed an increase of reports compared to lockdown for all 3 months.

Characteristics of reported oral ingestions

Most cases involved young children, with children under the age of 6 consistently representing more than 75% of exposures throughout the study period (Table2). We observed a statistically significant change of age distribution over the different years (x2= 78.353, p < 0.001). Notably, during lockdown, a statistically significant overrepresentation was observed in early childhood and preschool children with 1044 (40.3% (95% CI, 38.4%-42.2%)) and 329 (12.7% (95% CI, 11.4%-14.0%) cases respectively, as well as a statistically significant underrepresentation of adolescents with 172 (6.6% (95% CI, 5.6%-7.6%) cases (Table2). We noticed a statistically significant change of victim location over the different years (x2=76.870, p < 0.001). During lockdown, we observed a statistically significant overrepresentation of exposures occurring at home with 2282 (88.0% (95% CI, 86.7%-89.3%) cases reported, as well as a statistically significant underrepresentation of reported exposures occurring at educational institutions and hospitals with 17 (0.7% (95% CI, 0.4%-1.0%) and 240 (9.3% (95% CI, 8.2%-10.4%) cases respectively (Table2). Furthermore, we also observed a statistically significant overrepresentation of exposures occurring in hospitals in 2021 (Table2). We observed a decrease of referrals to the emergency department/hospital during lockdown, compared to 2019 (300 (11.6% (95% CI, 10.4%-12.8%) vs 352 (13.3% (95% CI, 12.0%-14.6%)), as well as an increase in non-referrals during lockdown compared to 2019 (2219 (85.6% (95% CI, 84.2%-87.0%) vs 2224 (83.7% (95% CI, 82.3%-85.1%))

Discussion

This retrospective analysis of pediatric oral exposures reported to the Belgian Poison Center during the COVID-19 lockdown provides critical insights into the unintended consequences of public health measures on child safety. Our findings demonstrate significant changes in exposure patterns to hand sanitizers, bleaching agents, and detergents, coinciding with the heightened preventive behaviors associated with the pandemic. The true exposure remains difficult to assess as only the documented reports could be studied. Misinformation disseminated by the media regarding hygiene practices may have also contributed to these changes though we did not explicitly assess its impact on our data (14, 15). These results contribute to the growing body of evidence highlighting the need for targeted interventions to reduce the risks of accidental oral ingestions in children during public health crises (16, 17). Opportunities to strengthen the current product safety standard to further reduce exposures exist and have been proposed even before the COVID-19 pandemic, as well as possible natural alternatives to chemical-based hand sanitizers (18, 19).

The most striking finding in this study is the dramatic surge in oral ingestion cases with hand sanitizers, which increased by 329% during the lockdown period compared to 2019. The rapid adoption of hand hygiene measures during the early stages of the pandemic, driven by fears of SARS-CoV-2 transmission via contaminated surfaces, likely contributed to this sharp rise. The persistence of elevated hand sanitizer ingestion cases in the following years (234% increase in 2021 and 127% in 2022) underscores the continued risks associated with these products. Additionally, our study identified notable increases in cases of oral ingestion with bleaching products and detergents, with an overall increase of 163% and 30%, respectively, during the lockdown. These increases are likely reflective of the expanded use of cleaning agents driven by stricter sanitation measures during the lockdown. These findings are consistent with other international studies, which reported significant increases in calls to poison centers regarding hand sanitizers and household products during the pandemic's early months (9-13). Interestingly, despite a notable global trend of drug stockpiling during the pandemic, cases of oral ingestion involving human medications decreased by 20% during the same

TABLE 2: Characteristics of the studied exposure calls received by the Belgian Poison Center in 2019, 2020, 2021 and 2022 (1st March– 31st May).

	2019 n (%)	2020 n (%)	2021 n (%)	2022 n (%)	p
All cases	**2657**	**2591**	**2406**	**2644**	
Age group (years)					<0,001
Infant/Toddler (<2 years)	792 (29.8)	779 (30.1)	716 (29.8)	771 (29.2)	
Early childhood (≥2 and <4 years)	1068 (40.2)	1044 (40.3)*	872 (36.2)	937 (35.4)§	
Preschool (≥4 and <6 years)	291 (11.0)	329 (12.7)*	254 (10.6)	304 (11.5)	
Schoolchild (≥6 and <12 year)	289(10.9)	267 (10.3)	277 (11.5)	329 (12.4)	
Adolescent (≥12 and <18 years)	217 (8.1)§	172 (6.6)§	287 (11.9)*	303 (11.5)*	
Victim location					<0,001
Educational institutions	73 (2.8)*	17 (0.7)§	50 (2.1)	56 (2.1)	
Home	2187 (82.3)	2282 (88.0)*	1968 (81.8)	2201 (83.2)	
Hospital	332 (12.5)	240 (9.3)§	325 (13.5)*	290 (11.0)	
Other	65 (2.4)	52 (2.0)§	63 (2.6)	97* (3.7)	
Referred treatment location					<0,001
Emergency/hospital	352 (13.3)*	300 (11.6)	284 (11.8)	275 (10.4)	
GP	67 (2.5)	51 (2.0)	59 (2.5)	62 (2.3)	
Intensive care	6 (0.2)	12 (0.5)	9 (0.3)	2 (0.0)	
Non referral	2224 (83.7)	2219 (85.6)	2044 (85.0)	2298 (86.9)	
Specialist	8 (0.3)	9 (0.3)	10 (0.4)	7 (0.3)	

* Statistically significant positive adjusted residuals with Bonferroni correction (Critical value Z depending on significance threshold) (p<0.001)
§ Statistically significant negative adjusted residuals with Bonferroni correction (Critical value Z depending on significance threshold) (p<0.001)

period. This finding aligns with reports from other international studies, further supporting the observed decrease (9, 20). Further research is needed to fully understand the relationship between drug stockpiling and changes in drug ingestion cases during the pandemic

The age distribution of exposures in this study also warrants significant attention. Consistent with previous literature, children under the age of six accounted for most oral ingestion cases, with a disproportionately high number of incidents in the early childhood (40.3%) and preschool (12.7%) age groups during the lockdown (21, 22). The increased time spent indoors during the lockdown, coupled with changes in household routines, likely provided more opportunities for young children to come into contact with hazardous substances. On the other hand, the decrease in adolescent exposures (from 8.1% in 2019 to 6.6% in 2020) may reflect a combination of factors, including increased awareness of safety precautions and reduced environmental exposure, as schools were restricted.

This analysis also revealed a significant shift in the location of exposures, with a significant increase and disproportionately high number of incidents occurring at home during the lockdown (88.0% of all cases in 2020), compared to 2019 (82.3%). On the other hand, the study revealed a significant decrease of incidents occurring in schools and hospitals. This shift reflects the closure of schools and highlights the home environment as a key area for prevention efforts during lockdowns. Additionally, the decrease in hospital-related exposures could be attributed to the fear of contracting COVID-19 in healthcare settings, leading families to contact poison control centers instead of seeking emergency care.

Another finding of this study is the decrease in referrals to the emergency department/hospital during the lockdown, compared to 2019, with non-referrals increasing correspondingly. This is a trend that has already been described by other international studies and may have been explained by a climate of fear for COVID-19 infection when visiting a hospital or emergency room (23, 24).

The strengths of this study include its large sample size and the timely collection of data during an unprecedented global health crisis, providing valuable insights into the impact of the COVID-19 lockdown on pediatric toxic oral ingestion patterns. However, our study also has limitations. First, the retrospective nature of the data restricts our ability to establish causal relationships. Second, we were unable to assess the effectiveness of specific preventive measures implemented during the pandemic, which warrants further research. Additionally, our analyses rely on reports submitted to the Belgian Poison Center, which likely capture only a fraction of total exposures, as some cases may have been managed independently at home or treated through in-person medical attention. Moreover, poison center specialists rely on reported information to manage and treat exposures, meaning that the data in their case management systems is influenced by the accuracy of the description of the caller, potentially leading to underreporting or misclassification of cases.

Conclusion

This study provides valuable evidence of the significant shifts in pediatric oral ingestion patterns with hand sanitizers, bleaching agents, detergents, and human medication during the COVID-19 lockdown. These findings highlight the need for sustained public health efforts to ensure the safe use of household products and to mitigate the risks of unintentional exposures in children, especially during public health emergencies. Future research should evaluate the effectiveness of preventive interventions, including public awareness campaigns and product safety regulations, to mitigate pediatric toxic oral ingestion risks during such crises.

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