

# Household disinfectant exposure during the COVID-19 pandemic: a retrospective study of the data from an Italian poison control center

P.M. SOAVE<sup>1,2</sup>, S. GRASSI<sup>3</sup>, A. OLIVA<sup>3</sup>, B. ROMANÒ<sup>2</sup>, E. DI STASIO<sup>4</sup>,  
L. DOMINICI<sup>1</sup>, V. PASCALI<sup>3</sup>, M. ANTONELLI<sup>2</sup>

<sup>1</sup>Poison Control Center, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy

<sup>2</sup>Anesthesia, CPR, Intensive Therapy and Medical Toxicology, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy

<sup>3</sup>Department of Health Surveillance and Bioethics, Section of Legal Medicine, Fondazione Policlinico A. Gemelli IRCCS, Università Cattolica del Sacro Cuore, Rome, Italy

<sup>4</sup>Institute of Biochemistry and Clinical Biochemistry, Università Cattolica del Sacro Cuore, Rome, Italy

*Paolo Maurizio Soave, Simone Grassi, and Antonio Oliva equally contributed to this work and thus should be considered co-first authors*

**Abstract. – OBJECTIVE:** Since the beginning of the COVID-19 pandemic it has been recommended that chemical disinfectants are used to protect surfaces. This study aimed to determine whether the number of exposure calls related to household disinfectants (HD) received between January 30, 2020 to May 18, 2020 varied from the same time period in the previous year.

**MATERIALS AND METHODS:** A retrospective review of the poison control center database from the Fondazione Universitario Policlinico Agostino Gemelli IRCCS, Rome, Italy, was conducted. Calls from Italian citizens, hospitals, and general practitioners received during the same time period in 2019 and 2020 were compared.

**RESULTS:** The center received 1972 exposure calls during the study period. A 5% increase in calls regarding exposure to HDs was noted from 2019 to 2020 (9.8% to 15.2%,  $p < 0.001$ ). The majority of enquiries regarded bleach-containing products, hand sanitizers, ethanol, and hydrogen peroxide. Most calls were received from patients in their homes (n, 259; prevalence, 86%; increase, 107%) and concerned accidental exposure (n, 280; prevalence, 93%; increase, 76%), while cases of intentional exposure decreased (n, 14; prevalence, 5%; decrease, 33%). The main route of exposure was ingestion (n, 170; prevalence, 57%; increase, 45%), but the highest increase was observed in inhalation cases (n, 82; prevalence, 27%; increase, 122%).

**CONCLUSIONS:** As the incidence of enquiries regarding products that can represent an important health hazard, when improperly used, increased in 2020 suggests that the COVID-19 public health messaging on the proper use of HDs should be improved.

*Key Words:*

Household disinfectants, Poison control center, COVID-19, SARS-CoV-2, Risk management.

## Introduction

On January 30, 2020 the World Health Organization (WHO) declared the COVID-19 outbreak a public health emergency of international concern<sup>1</sup>. The WHO recommends the application of chemical disinfectants, such as chlorine or alcohol, to surfaces after cleaning them during the pandemic<sup>2</sup>. Chang et al<sup>3</sup> compared the number of calls received by the United States (US) poison centers during the period between January-March 2020 with the data obtained during the same 3-months in 2018 and 2019. They showed that the number of reported exposures to cleaners and disinfectants (in particular, bleaches, nonalcohol disinfectants, and hand sanitizers) increased in 2020<sup>3</sup>. Italy had Europe's highest number of COVID-19 cases and infection-related deaths for a considerable period of time<sup>4,5</sup>. For this reason, on March 9, 2020 the Italian government imposed a national quarantine, that lasted until May 18, 2020, when there was a substantial reduction in daily cases and deaths. We analyzed the telephone enquiries received by the poison control center of the Fondazione Universitario Policlinico Agostino Gemelli IRCCS (Rome, Italy) from January 30, 2020 to

May 18, 2020 (the period of the first half of the year during which the incidence of COVID-19 cases and deaths were at their highest). Our aim was to evaluate and compare the data from 2020 with those obtained during the same period in 2019, and whether during this period the number of exposure calls related to household disinfectants (HD) varied.

## Materials and Methods

A retrospective review of the database from the poison control center of the Fondazione Universitario Policlinico Agostino Gemelli IRCCS was conducted. We focused on the exposure calls related to HDs received between January 30, 2020 to May 18, 2020. The operators classified all the household chemicals according to their antimicrobial properties (e.g., bleach, ethanol, hand sanitizers) as 'household disinfectants'. The enquiries received were from citizens, hospitals, and general practitioners from the entire national territory. For each enquiry, we considered the following information: the type of product, whether the enquirer was a citizen or from a hospital, and the type/route of exposure. We compared the data from January 30, 2020 to May 18, 2020 with those obtained during the same period in 2019 in order to evaluate whether the incidence of adverse reactions to HDs significantly varied between these time periods.

No approval from Ethics Committee was required. There are no conflicts of interest to declare.

### Statistical Analysis

The statistical analyses were performed using the IBM SPSS® software platform 15.0 (IBM Inc., Chicago IL, USA). The frequencies of events in different years were compared using the  $\chi^2$ -test. A *p*-value less than 0.05 was considered statistically significant.

## Results

The poison control center received 1972 exposure calls between January 30, 2020 and May 18, 2020, whereas 1862 were received in the same period in 2019 (Table I).

When comparing the 2020 with the 2019 data, a 5% increase in the prevalence of exposure calls regarding HDs was noted (15.2% vs. 9.8%, respectively,  $p < 0.001$ ) (Figure 1).

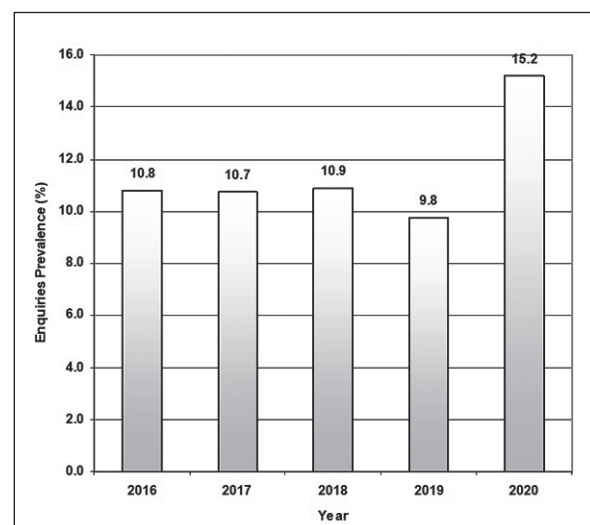
**Table I.** The number of enquiries received between January 30 and May 18 by the poison control center regarding household disinfectants for the years 2016-2020

Year	Number of Enquiries
2016	1940
2017	1314
2018	1488
2019	1862
2020	1972

The majority of the enquiries were regarding bleach-containing products (n, 121; prevalence, 40%; increase, 108%), ethanol-based hand sanitizers (n, 50; prevalence, 17%; increase, 127%), ethylic alcohol (n, 21; prevalence, 7%; increase, 50%), and hydrogen peroxide (n, 17; prevalence, 6%; increase, 55%). Most of the calls received were from patients in their homes (n, 259; prevalence, 86%; increase, 107%) and concerned accidental exposures (n, 280; prevalence, 93%; increase, 76%), while cases of attempted suicide/self-harm using these products decreased (n, 14; prevalence, 5%; decrease, 33%). The main route of exposure was ingestion (n, 170; prevalence, 57%; increase, 45%), but the highest increase was observed in inhalation cases (n, 82; prevalence, 27%; increase, 122%) (Table II).

## Discussion

According to the data we collected, between January 30, 2020 and May 18, 2020 both the



**Figure 1.** The prevalence of household disinfectant related enquiries in 2016-2020 between January 30 to May 18.

**Table I.** The frequency and increase of calls regarding household disinfectants, the type of enquirer, type of exposure, and route of exposure between 2019 and 2020.

Product	2019 (n = 182) n (frequency %*)	2020 (n = 300) n (frequency %*)	Increase (%)
Bleach-containing products	58 (32%)	121 (40%)	+108%
Hand sanitizers	22 (12%)	50 (17%)	+127%
Ethyl Alcohol	14 (8%)	21 (7%)	+50%
Hydrogen peroxide	11 (6%)	17 (6%)	+55%
Other products	77 (42%)	91 (30%)	+18%
<b>Enquirers</b>			
Patients in their homes	125 (69%)	259 (86%)	+107%
Hospitals	52 (29%)	36 (12%)	-31%
Other	5 (2%)	5 (2%)	0%
<b>Type of exposure</b>			
Accidental	159 (88%)	280 (93%)	+76%
Intentional	21 (12%)	14 (5%)	-33%
Occupational	2 (1%)	6 (2%)	+200%
<b>Route of exposure</b>			
Ingestion	117 (65%)	170 (57%)	+45%
Inhalation	37 (20%)	82 (27%)	+122%
Cutaneous/Mucosal	28 (15%)	48 (16%)	+71%

\*Relative to total phone calls.

absolute number of enquiries and the prevalence of enquiries regarding HDs were significantly higher than in previous years (Figure 1).

HDs such as chlorine and quaternary ammonium salts are amongst the most common household products in the US and Europe<sup>6,7</sup>. The toxicity of HD is highly variable, depending on the main active substance, its dose/concentration, and the route of exposure<sup>6</sup>. They are generally effective and safe when used correctly, but their improper use can represent an important health hazard<sup>8</sup>.

Gharpure et al<sup>9</sup> reported that more than one third of their survey responders admitted having engaged in high-risk practices such as washing food with bleach or inhaling/ingesting hand sanitizers, during the COVID-19 pandemic<sup>9</sup>.

When a chemical is improperly used, poison control centers play a strategical role in assessing the actual health risk and if necessary, indicating the correct management of the intoxication<sup>10</sup>.

### Products

In the present study, the most commonly reported products contained bleach, ethyl alcohol, or hydrogen peroxide, or were ethanol-based hand sanitizers, and the exposure calls regarding these substances significantly increased in comparison to the same period in 2019. This data is consistent with the evidence found by Chang et al<sup>3</sup> who reported a significant increase in calls regarding bleaches and hand sanitizers<sup>3</sup>.

The toxicity of bleach-containing household products is due to sodium hypochlorite, that can cause oxidative injury and necrosis through the formation of hypochlorous acid and superoxide radicals<sup>6,11,12</sup>. Therefore, their toxicity mainly depends on the concentration of sodium hypochlorite and on the route of administration, for example toxicity of bleach is significantly lower when infused intravenously than when ingested<sup>6</sup>. Common bleach-containing products are generally safe when used topically, but when ingested, they can cause internal burns and mucosal edema and when inhaled, respiratory tract injuries, for example, in cases of high-dose exposure, acute respiratory distress syndrome can occur<sup>6</sup>.

While chronic and excessive ingestion of alcohol is well-known to be associated with severe consequences, ethanol-containing dermatological products, particularly hand disinfectants, are generally considered safe. However, some authors have reported allergic contact dermatitis or contact urticaria syndrome induced by topical exposure to ethanol, but it is unclear if in these cases the actual cause of the reaction was represented by ethanol, its metabolites, or an additive, and in any case this kind of toxicity appears to only affect children or patients with damaged skin<sup>13</sup>.

Finally, household products containing hydrogen peroxide are also frequent causes of domestic poisoning, especially in pediatric aged cases<sup>14,15</sup>.

In particular, they can cause caustic injuries if ingested, subglottic edema, and laryngospasm if inhaled<sup>14</sup>.

### **Enquirers**

The majority of enquiries received were from patients in their homes, while the number of enquiries received from hospitals decreased. Even before the COVID-19 pandemic, exposures mainly occurred at home, but, in our opinion, these data are still of great interest, since they could suggest that patients prefer to contact poison control centers and to try to treat the intoxication in their homes rather than directly going to emergency rooms. This could be due to the fear of contracting COVID-19 in the hospitals, since they are considered high-risk environments.

### **Type of Exposure**

Most of the exposures were accidental and cases of self-harm, attempted suicide, and suicide decreased. This evidence is consistent with the findings of Gharpure et al<sup>9</sup> who reported an increased incidence of accidental improper use of household chemicals (e.g., for disinfecting food)<sup>9</sup>. The reduction in the incidence of intentional poisoning is interesting, particularly as some authors underlined that social isolation (quarantine) could increase suicidal risk<sup>16</sup>. However, our data did not exclude other means that could have been used to commit suicide.

### **Route of Exposure**

Exposure to HD occurred mainly as a result of ingestion, but the highest increase was observed in the incidence of inhalation cases. This evidence is consistent with the data reported by Chang et al<sup>3</sup>. The increase in inhalation cases could be in part explained by an increase in exposure to bleach-containing products, since irritating chlorine vapors released by mixtures of sodium hypochlorite and a mild acid represent the most common inhalation hazard in the household<sup>17</sup>.

## **Conclusions**

During the COVID-19 pandemic, use of disinfectants to clean surfaces is indicated, but, when these chemicals are not properly used, they can be harmful. Our data shows that during the period we considered that 93% of the exposures were accidental and that the incidence of enquiries regarding products such as bleaches, that can

represent an important health hazard in cases of improper use (e.g., mixture with other products), significantly increased. COVID-19 public health messaging should be improved and aim to educate citizens on safe disinfection practices and on the health hazards that can arise from the improper use of these products that are used daily in households. This intervention is particularly valuable and urgent because the incidence of COVID-19 is rapidly increasing again, and national quarantines are being reintroduced in many Western countries<sup>18,19</sup>.

### **Conflict of Interest**

The Authors declare that they have no conflict of interests.

### **Declaration of Funding Interests**

This work has been supported by Fondi di Ateneo, Linead D1 - Università Cattolica del Sacro Cuore, Grant n. R4124500772 (Recipient: Antonio Oliva).

## **References**

- 1) [https://www.who.int/dg/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-\(2019-ncov\)](https://www.who.int/dg/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-(2019-ncov)). January 30, 2020
- 2) <https://www.who.int/publications/i/item/cleaning-and-disinfection-of-environmental-surfaces-in-the-context-of-covid-19>. May 15, 2020
- 3) Chang A, Schnall AH, Law R, Bronstein AC, Marraffa JM, Spiller HA, Hays HL, Funk AR, Mercurio-Zappala M, Calello DP, Aleguas A, Borys DJ, Boehmer T, Svendsen E. Cleaning and Disinfectant Chemical Exposures and Temporal Associations with COVID-19 - National Poison Data System, United States, January 1, 2020-March 31, 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69: 496-498.
- 4) Okell LC, Verity R, Watson OJ, Mishra S, Walker P, Whittaker C, Katzourakis A, Donnelly CA, Riley S, Ghani AC, Gandy A, Flaxman S, Ferguson NM, Bhatt S. Have deaths from COVID-19 in Europe plateaued due to herd immunity? *Lancet* 2020; 395: e110-e111.
- 5) Di Lorenzo G, Di Trolio R. Coronavirus Disease (COVID-19) in Italy: analysis of risk factors and proposed remedial measures. *Front Med (Lausanne)* 2020; 7: 140.
- 6) Peck B, Workeneh B, Kadikoy H, Patel SJ, Abdellatif A. Spectrum of sodium hypochlorite toxicity in man-also a concern for nephrologists. *NDT Plus* 2011; 4: 231-235.
- 7) Elersek T, Ženko M, Filipič M. Ecotoxicity of disinfectant benzalkonium chloride and its mixture with antineoplastic drug 5-fluorouracil towards al-

- ga Pseudokirchneriella subcapitata. PeerJ 2018; 6: e4986.
- 8) Aquila I, Sacco MA, Abenavoli L, Malara N, Arena V, Grassi S, Ausania F, Boccuto L, Ricci C, Gratteri S, Oliva A, Ricci P. Severe Acute Respiratory Syndrome Coronavirus 2 Pandemic. Arch Pathol Lab Med 2020; 144: 1048-1056.
  - 9) Gharpure R, Hunter CM, Schnall AH, Barrett CE, Kirby AE, Kunz J, Berling K, Mercante JW, Murphy JL, Garcia-Williams AG. Knowledge and practices regarding safe household cleaning and disinfection for COVID-19 prevention - United States, May 2020. MMWR Morb Mortal Wkly Rep 2020; 69: 705-709.
  - 10) Tangiisuran B, Jiva Mx, Ariff AM, Abdul Rani NA, Misnan A, Rashid SM, Majid MIA, Dawson AH. Evaluation of types of poisoning exposure calls managed by the Malaysia National Poison Centre (2006-2015): a retrospective review. BMJ Open 2018; 8: e024162.
  - 11) Hidalgo E, Bartolome R, Dominguez C. Cytotoxicity mechanisms of sodium hypochlorite in cultured human dermal fibroblasts and its bactericidal effectiveness. Chem Biol Interact 2002; 139: 265-282.
  - 12) Harley EH, Collins MD. Liquid household bleach ingestion in children: a retrospective review. Laryngoscope. 1997; 107:122-5.
  - 13) Lachenmeier DW. Safety evaluation of topical applications of ethanol on the skin and inside the oral cavity. J Occup Med Toxicol 2008; 3: 26.
  - 14) Pritchett S, Green D, Rossos P. Accidental ingestion of 35% hydrogen peroxide. Can J Gastroenterol 2007; 21: 665-667.
  - 15) Mahaseth T, Kuzminov A. Potentiation of hydrogen peroxide toxicity: from catalase inhibition to stable DNA-iron complexes. Mutat Res 2017; 773: 274-281.
  - 16) Gunnell D, Appleby L, Arensman E, Hawton K, John A, Kapur N, Khan M, O'Connor RC, Pirkis J; COVID-19 Suicide Prevention Research Collaboration. Suicide risk and prevention during the COVID-19 pandemic. Lancet Psychiatry 2020; 7: 468-471.
  - 17) Rauber-Lüthy C, Kupferschmidt H. Household chemicals: management of intoxication and antidotes. EXS 2010; 100: 339-363.
  - 18) Oliva A, Caputo M, Grassi S, Vetrugno G, Marazza M, Ponzanelli G, Cauda R, Scambia G, Forti G, Bellantone R, Pascali VL. Liability of Health Care Professionals and Institutions During COVID-19 Pandemic in Italy: Symposium Proceedings and Position Statement. J Patient Saf 2020 Sep 15. doi: 10.1097/PTS.0000000000000793. Epub ahead of print.
  - 19) Della Rossa F, Salzano D, Di Meglio A, De Lellis F, Coraggio M, Calabrese C, Guarino A, Cardona-Rivera R, De Lellis P, Liuzza D, Lo Iudice F, Russo G, di Bernardo M. A network model of Italy shows that intermittent regional strategies can alleviate the COVID-19 epidemic. Nat Commun 2020; 11: 5106.