United States
Consumer Product Safety Commission

This document has been electronically approved and signed.

Ballot Vote Sheet

TO: The Commission
Alberta E. Mills, Secretary

DATE: July 26, 2023

THROUGH: Austin C. Schlick, General Counsel
Jason Levine, Executive Director

FROM: Daniel R. Vice, Assistant General Counsel, Regulatory Affairs
David M. DiMatteo, Attorney, Regulatory Affairs

SUBJECT: Petition Requesting Rulemaking to Establish Safety Standard for Aerosol Duster Products (Petition CP 21-1)

BALLOT VOTE DUE: Tuesday, August 1, 2023

CPSC staff has prepared for the Commission a briefing package regarding a petition for rulemaking submitted by Families United Against Inhalant Abuse. The underlying petition requests that the Commission initiate rulemaking to adopt a mandatory CPSC safety standard to address the safety hazards associated with intentional inhalation of fumes from aerosol duster products containing the chemical 1,1-Difluoroethane or any derivative thereof. On June 29, 2021, the Commission published a *Federal Register* notice seeking comment on the petition. In July 2022, the Commission voted to defer the petition to allow staff further time to research issues related to the hazard identified in the petition. The new staff briefing package recommends the Commission grant the petition and direct staff to initiate rulemaking.

Please indicate your vote on the following options:

I. Grant Petition CP 21-1, and direct staff to initiate rulemaking.

______________________________ ____________________
(Signature) (Date)

II. Defer Petition CP 21-1.

______________________________ ____________________
(Signature) (Date)

III. Deny Petition CP 21-1.

______________________________ ____________________
(Signature) (Date)

IV. Take other action specified below.

(Signature) (Date)

Attachment: *Staff Briefing Package on Petition CP 21-1*

United States
Consumer Product Safety Commission

Staff Briefing Package – Aerosol Duster Petition

July 26, 2023

This report was prepared by the CPSC staff.
It has not been reviewed or approved by,
and may not necessarily reflect the views of,
the Commission.

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Executive Summary

On April 2, 2021, Families United Against Inhalant Abuse (FUAIA, Petitioner), submitted a petition requesting that the U.S. Consumer Product Safety Commission (CPSC) initiate rulemaking to adopt a mandatory safety standard "to address the hazards associated with aerosol "duster" products used for cleaning electronics and other items and containing the chemical 1,1-difluorethane, or any derivative thereof."

In July 2022, staff presented a briefing package to the Commission recommending that the Commission defer action on the petition to allow staff further time to research issues relating to the hazard identified in the petition. On July 26, 2022, the Commission voted to defer action on the petition. On October 26, 2022, the Commission approved the Fiscal Year 2023 Operating Plan which included a milestone to submit a staff briefing package on aerosol dusters to the Commission before the end of FY23. Staff is now submitting a briefing package recommending that the Commission grant the petition.

1,1, Difluoroethane (DFE) is commonly used in aerosol dusters and is the drug of choice for many inhalant abusers because of its low cost, ease of access and immediate euphoria without the lingering effects like other drugs. Aerosol dusters contain nominally 100% DFE that is administered directly into the lungs resulting in a quick high with minimal "hangover" symptoms. The drug effects of DFE clear quickly from the body, leading inhalant abusers to engage in frequent repeated (within minutes) use of the aerosol duster to maintain a high. From 2015-2019, approximately 86,000 people per month and 269,000 people per year abused aerosol dusters to get high, as estimated by CPSC staff. The National Survey on Drug Use and Health (2020) indicates that, not including alcohol and tobacco, inhalants are the second most abused drug among high school students after cannabis.

Although dusters frequently are sold as seemingly innocuous "canned air," inhalation of the DFE propellant in dusters by inhalant abusers can cause severe injury or death. Between 2006 and 2022, CPSC received reports for 1,210 unique incidents involving inhalation hazards from aerosol dusters, and an additional 1,115 unique fatal incidents involving DFE toxicity (products were not listed in narrative so it is unknown how many were from dusters). An overwhelming majority (99.3%) of the aerosol duster inhalation incidents in Consumer Product Safety Risk Management System (CPSRMS) reported between 2006 and 2022 resulted in deaths, with most victims (95%) being between the ages of 18 and 54. Between 2006 and 2022, it is estimated that there were 28,800 emergency department (ED) treated injuries resulting from inhalation of aerosol duster products in the United States. This estimate is based on a sample of 638 National Electronic Injury Surveillance System (NEISS) injury cases.

The total cost to society of injuries and fatalities associated with aerosol dusters is estimated to range from $1.031 billion to $1.837 billion per year, with an estimated cost of approximately $50 to over $90 per canister produced. The estimated annual cost to society from fatalities is $868 million to $1.674 billion per year. The estimated annual cost to society from injuries is $163 million per year.

Staff looked at potential remedies to address the hazard presented by DFE in aerosol dusters, including the use of a different propellant and engineering design changes to the can. In addition, alternative products may be safer substitutes, such as electronic dusters, which produce an air speed comparable to aerosol duster products and exceed aerosol dusters for duration of use.

Staff notes that some dusters use alternative propellants, including hydrofluoroolefins (HFO), a new generation of refrigerants with a low potential to increase global warming, which are used as propellants for aerosol dusters, but for which toxicity and abuse potential are unknown. Staff also has concluded that some currently available chemical propellants may not be suitable for use in consumer aerosol duster products or may provide limited benefits or diminished consumer utility compared to DFE due to their already known abuse potential (volatile hydrocarbons, dimethyl ether, and nitrous oxide), or the known technical difficulties or limitations of using them in aerosol duster applications (carbon dioxide, nitrogen, ethane). The human toxicity and abuse potential for HFO are unknown. HFO dusters are commercially available currently as an alternative to DFE and 1,1,1,2-tetrafluoroethane dusters (HFC-134a).

The age range of users that abuse and intentionally inhale gases from aerosol dusters is wide, predominantly falling between the ages of 13 and 70. This age range also includes consumers that use aerosol dusters for their intended purpose. Both proper use and abuse of aerosol duster products occur within this age range. Therefore, it would be extremely difficult to create a locking mechanism that allows access for those using the product properly while preventing abusers from accessing the DFE within the aerosol duster. The lid and trigger designs for aerosol dusters currently on the market are locking mechanisms intended to prevent accidental spraying and to keep young children from activating the trigger but are not effective for denying access to abusers of the product.

The health risks that result from inhaling aerosol duster products are very serious and include the risk of death. Staff recommends that the Commission grant the petition to allow staff to work on performance requirements to mitigate the risks associated with DFE containing aerosol duster products.

Briefing Memorandum

TO:	The Commission Alberta E. Mills, Secretary	**DATE:** July 26, 2023
THROUGH:	Austin C. Schlick, General Counsel Jason K. Levine, Executive Director DeWane Ray, Deputy Executive Director for Safety Operations	
FROM:	Duane E. Boniface, Assistant Executive Director Office of Hazard Identification and Reduction Cheryl Scorpio, Ph.D. Project Manager, Aerosol Duster Petition Division of Pharmacology and Physiology Assessment Directorate of Health Sciences	
SUBJECT:	CP 21-1: Staff Briefing Package for the Aerosol Duster Petition	

I. Introduction

On April 2, 2021, Families United Against Inhalant Abuse (FUAIA, Petitioner) submitted a petition to the U.S. Consumer Product Safety Commission, requesting that the Commission initiate rulemaking to adopt a mandatory safety standard "to address the hazards associated with "duster" aerosol products containing the chemical 1,1-difluorethane, or any derivative thereof."

The Directive Implementing Procedure 302 for Petitions, section 4(c)(1) states the following regarding staff's responsibilities:

> Prepare a briefing memorandum to advise the Commission regarding the petition. The briefing memorandum shall provide the Commission with preliminary information concerning the petition so the Commission can make an initial assessment. The information and analyses in the briefing memorandum generally will be concise and based on existing or easily obtainable data, and will vary, depending on the petition.

Section 4(c)(3) further states regarding the content of a briefing package:

> The briefing memorandum shall contain a brief assessment of the petition and staff's recommendation of whether the Commission should grant, deny, or defer action on the petition. Generally, and to the extent it is available from existing or easily obtainable data, the briefing memorandum should provide preliminary information about the following, if feasible. [Followed by a list of topics that should be addressed in a briefing package].

In July 2022, Staff submitted a briefing package[1] to the Commission regarding the petition and found that the use of bitterants and a change in labeling would not adequately address the issue of death due to DFE abuse. The staff recommended that the Commission defer the petition to allow time for more research to be done on the subject. On July 26, 2022, the Commission voted to defer the petition. On October 26, 2022, the Commission approved the Fiscal Year 2023 Operating Plan which included a milestone to submit another briefing package to the Commission on aerosol dusters before the end of FY23.

Staff evaluated injury data in the CPSC databases, publicly available data from medical journals, databases, industry publications, spoke with experts in the field of aerosol abuse, and used data from a market contract to further investigate the abuse of aerosol duster products. This Briefing Memorandum summarizes staff's findings and recommends that the Commission grant the petition and direct staff to develop a notice of proposed rulemaking briefing package to address the unreasonable risk of injuries and deaths due to inhalant abuse of aerosol dusters.

II. Factors Relevant to the Commission's Decision on a Petition

The CPSC's petition regulation describes the factors the Commission must consider when deciding whether to grant or deny a petition. The relevant factors include:

(1) Whether the product involved presents an unreasonable risk of injury;

(2) Whether a rule is reasonably necessary to eliminate or reduce the risk of injury; and

(3) Whether failure of the Commission to initiate the rulemaking proceeding requested would unreasonably expose the petitioner or other consumers to the risk of injury which the petitioner alleges is presented by the product.

16 C.F.R. § 1051.9(a).

The regulation also states: "[I]n considering these factors, the Commission will treat as an important component of each one the relative priority of the risk of injury associated with the product about which the petition has been filed and the Commission's resources available for rulemaking to activities with respect to that risk of injury." 16 C.F.R. § 1051.9(b).

Staff considered these factors when evaluating the aerosol duster petition and in developing the recommendations detailed in this briefing package.

III. Discussion

A. Health Sciences

1. The Addiction Patterns of Aerosol Dusters (Tab A)

Although aerosol duster products are commonly referred to as "canned air," they contain nominally 100% DFE, that is used as a propellant and can be inhaled.[2] Inhalants are legal,

[1] https://www.cpsc.gov/s3fs-public/Petition-Requesting-Rulemaking-to-Establish-Safety-Standard_0.pdf?VersionId=GNEl7pYZUBOxf1BLSC0f4.X6TlA8gT4f.

[2] Aerosol propellant is a liquid which exists in equilibrium with a gas (liquified propellant such as DFE), or compressed gas that are used to expel aerosol content from a pressurized container. In the case of aerosol dusters, propellant is a single component of the aerosol.

widely available, inexpensive,[3] and easily concealed for intentional misuse by abusers (Williams, 2007). DFE causes hypoxia[4] and lightheadedness (Bowen, 2011), and works through specific brain receptors to elicit psychological effects (Duncan, 2013). DFE from aerosol dusters is the “drug of choice" for someone choosing to abuse inhalants to get “high” because it contains nominally 100% DFE which is lipophilic,[5] can be sprayed directly into the lungs and goes directly to the brain to exert its effects.[6]

From 2015-2019, approximately 86,000 people per month and 269,000 people per year used aerosol dusters to get high as estimated by CPSC staff.[7] The National Survey on Drug Use and Health (2020) indicates, not including alcohol and tobacco, inhalants are the second most abused drug among high school students after cannabis (Cruz 2021).

Adolescents who abuse inhalants are likely polydrug[8] abusers. This group differs from other multidrug abuser groups in that their abuse of inhalants can range from moderate to severe (Beauvais, 2001). Inhalant-dependent adults typically almost exclusively use inhalants as their drug of choice, usually daily and often for several hours a day. Many abusers from this group experience acute and chronic physiological and psychological problems directly due to their inhalant abuse (Beauvais 2001). As the severity of inhalant-related problems increases, so too does the severity of co-occurring psychiatric and substance-related conditions. A risk behavior syndrome can be manifested as fearlessness and is associated strongly with inhalant abuse which might explain the association between inhalant abuse and multiple substance abuse disorders (Perron 2009, Wu 2008). Inhalant dependent youth scored greater in suicidality than those experiencing other psychiatric issues such as depression, anxiety, and traumatic experiences (Perron, 2009).

The motivation for abusers to quit using inhalants rarely occurs because of the low cost and easy availability of the product. If inhalant abusers do quit using inhalants it is because of tiring of using inhalants, disliking them, or health concerns[9] (Garland and Howard 2011, Tardelli, 2021).

In 2008, Wu determined that inhalant abusers were characterized by the early use of cigarettes, alcohol, and other drugs at younger ages. They were more likely to initiate heroin use by age 32 than those who had no history of inhalant abuse (Johnson, Schutz, Anthony, and Ensminger, 1995).[10] Children who abuse inhalants early in life are more likely to abuse other illicit drugs when they are adults (Anderson, 2003). Other theories of adolescent drug abuse include psychosocial[11] influences perpetuating the drug abuse pattern. A practical reason adolescent drug abusers have for switching to aerosol duster products use over other illicit drugs, is that

[3] Aerosol dusters are presumed to be less expensive than other abused drugs.
[4] A below-normal level of oxygen in your blood.
[5] Lipophilic is the tendency to combine or dissolve in lipids or fats.
[6] Personal Communication with Dr. Brian Perron, an inhalant abuse expert from the University of Michigan.
[7] Market and Economic Considerations for Petition Requesting the Commission Initiate Rulemaking to Adopt a Mandatory CPSC Safety Standard to Address the Hazards Associated with “Duster” Aerosol Products
[8] Those who abuse inhalants, as well as other drugs.
[9] Inhalants are associated with cardiac problems, dizziness, seizures, and decreased level of consciousness.
[10] Brian Perron personal communication.
[11] The inter-relationship of social factors and individual thought and behavior.

currently DFE is not as easy to monitor in drug tests as other drugs such as marijuana and alcohol. Currently there is no widely used available urine test to measure DFE.

A recent survey of 43,000 American adults suggests that inhalant abusers, on average, initiate the use of cigarettes, alcohol, and almost all other drugs at younger ages and display a higher lifetime prevalence of substance abuse disorders, including abuse of prescription drugs, when compared with substance abusers without a history of inhalant use.[12] Many individuals report a strong need to continue using inhalants; particularly those who have abused inhalants for prolonged periods of many days consecutively. Compulsive use and a mild withdrawal syndrome can occur with long-term inhalant abuse.

While there is no published study regarding the half-life for DFE after huffing, there are many recovery center websites on the internet which indicate that DFE from aerosol dusters does not stay in an abuser's system very long.[13] This is consistent with medical literature that states that inhalant abusers use volatile products that can produce a quick and generally pleasurable sensory experience or "high" with rapid dissipation and minimal "hangover" symptoms (Williams, 2007). Because of the short-lasting effect of DFE, inhalant abusers frequently use the chemical to prolong the high with repeated inhalations, which when done in excess can lead to loss of consciousness and even death (Williams, 2007).

Inhaling DFE-containing products produces psychological effects through the specific brain receptors for glutamate/NMDA, GABA, dopamine, and opioids and the intoxication caused by inhaling DFE is not caused by just lack of oxygen to the brain. Chemical and pharmacokinetic properties of the drugs, such as absorption, distribution, metabolism, half-life, and excretion influence the effects that any drug has. Aerosol dusters have the shortest half-life of 15 to 30 minutes and marijuana (THC) has the longest half-life of 3 to 11 days (Figure 1). After inhalation, patients reported intoxication to be a "kick/high/euphoria/ feeling of relaxation" with one or more of the following symptoms: giddiness, unsteadiness or perceptual disturbances, unconsciousness or delirium and lightheadedness (Bowen, 2011). The onset of the psychoactive effect of DFE is rapid[14] and conversely after inhalation, dissipation of the euphoric effects is also rapid (Wang, 2018).

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[12] What are the short- and long-term effects of inhalant use? | National Institute on Drug Abuse (NIDA) (nih.gov)
[13] https://www.therecoveryvillage.com
[14] 15 to 60 minutes

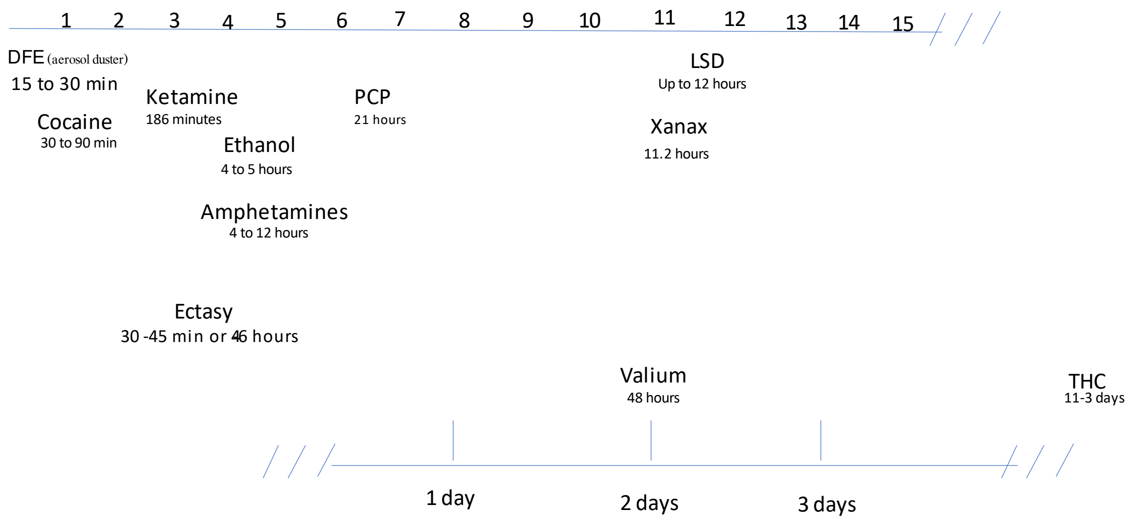

Figure 1: Half-life (time it takes for 50% of drug to be excreted from the body) of different drugs of abuse.

Addictive disorders can become permanent with high levels of craving and impulsivity (Alonso Matias 2019). Research has identified a possible withdrawal syndrome for DFE with symptoms that include irritability, headache, dry mouth, nausea, anorexia, sweating, tics, sleep disturbance and mood changes (Nguyen, 2016, Perron, Howard, Vaughn and Jarman, 2009). Inhalant abuse results in changes to neural psychological pathways of reward and reinforcement (Duncan, 2013).

<u>Auto Accidents Involving DFE Abuse</u>

Six automobile accidents following aerosol duster inhalation were identified by staff in the medical literature where three people died and three people recovered from the accident. Blood was collected from the victims in three incidents to test for DFE concentration (Tiscione, 2021). In one incident DFE was the only compound detected in the blood sample. In another incident, DFE and citalopram (an antidepressant) were detected. In the third case, DFE was detected but was below the level which could be accurately calculated for the method to be measured.

After consultation[15] with an inhalant expert, anecdotal evidence was found indicating that huffing 20g of DFE caused very erratic driving resulting in a car accident (Tiscione, 2021). In this incident, the driver had purchased 2 cans of aerosol duster approximately 20 minutes before the

[15] HS staff consulted with Dr. Brian Perron from the University of Michigan from the School of Social Work.

crash. One can was opened and weighed 20g less than the unopened can. It was suspected that the driver inhaled an aerosol duster product prior to the accident. Blood was collected to determine the DFE level for the individual. DFE was detected but was not able to be accurately quantified because it was below the limit of detection of the method, and therefore, was not able to be confirmed (Tiscione, 2021).

One aerosol duster can be sprayed approximately 125 times before it is empty. Anecdotal evidence suggests that even one spray from a can[16] is intoxicating enough to cause an individual driving a car to get into a car accident.

In Depth Investigation (IDI) of NEISS Incidents of DFE

CPSC performed twenty-five IDIs of NEISS incidents related to DFE from September 2022 through February 2023. All the incidents selected for an IDI involved aerosol dusters that contained DFE. Decedents were between the ages of 22 and 60 years old and most had previously used drugs and alcohol. Most of the deaths reported in the IDIs were indicated as being in the victim's home, specifically in the bedroom or bathroom. One victim started using aerosol dusters one month prior to her death. To commit suicide, one individual used over 20 cans. In another case a shopping bag had been found outside the front door of the deceased with multiple packs containing 2 cans of aerosol dusters. Details of these IDI cases are available in Appendix I of TAB A.

Conclusion

DFE abusers experience euphoria because aerosol dusters contain nominally 100% DFE which can be sprayed directly into the lungs and travel directly to the brain and exert its psychological effects. The "high" aerosol duster abuser's experience is rapid with minimal "hangover" symptoms. The onset of the psychoactive effect of DFE occurs through specific brain receptors. Huffing aerosol dusters containing DFE is addictive and associated with symptoms of craving and withdrawal. Automobile accidents have occurred after huffing DFE which result in injuries and death.

2. Alternative Propellants (Tab B)

DFE, or HFC-152a, is the most common propellant used in retail aerosol duster products (Chemtronics, 2022). Abusers of aerosol dusters spray the contents of the can into their mouths or inhale it from a cloth or bag. Other injuries resulting from aerosol duster abuse include frostbite, rapid airway compromise, cardiovascular and multi-organ toxicity, and cardiac arrhythmia (Perron et al., 2021; PubMed, 2018). Furthermore, abrupt cessation of DFE abuse can induce withdrawal[17] (PubMed Central, 2020). It would be highly desirable to prevent intentional aerosol duster inhalation to save lives and prevent injuries. Therefore, staff

[16] Personal Communication with Dr. Brian Perron, an inhalant abuse expert from the University of Michigan. One spray blast from a can of aerosol duster containing DFE is enough to get someone intoxicated.
[17] Withdrawal can include tremors, excessive sweating, nausea, vomiting, depression, anxiety, irritability, psychosis, and hallucinations.

considered the use of alternative propellants to DFE for use in aerosol duster products as discussed below.

Alternative Propellants

HFC-134a

DFE is the most common propellant used in retail aerosol dusters (Chemtronics, 2022). Similar abuse can occur for aerosol dusters using the propellant 1,1,1,2-tetrafluoroethane, or HFC-134a, which is popular for professional or industrial applications (Romero et al., 2022; Chemtronics, 2022; SDS, 2020). HFC-134a abuse can cause asphyxia, transient confusion, dangerous cardiac arrhythmias, acute cardiac, liver and kidney injury (Romero et al., 2022). CPSRMS has 14 reported cases of death from intentional HFC-134a inhalation (some in combination with DFE exposure) for the years 2006-2022 (Tab C), though staff notes that HFC-134a is also used in automobile refrigerant refill kits.

Volatile hydrocarbons and Dimethyl ether

Volatile hydrocarbons (propane, butane, isobutane, and their mixtures) and dimethyl ether (DME) are used as propellants in a variety of consumer products (PubMed Central, 2011). Volatile hydrocarbons and DME are known to be abused as inhalants (PubMed Central, 2011). Deaths have been reported in the literature for all of these chemicals and their mixtures (Table 1 Tab B). Volatile hydrocarbon abuse can lead to sudden death in some cases (PubMed, 2006). CPSRMS (from 2006-2022) has 5 reported cases of death from intentional propane inhalation (some in combination with ethane exposure, other in combination with butane and DFE exposure), 8 cases of death from intentional butane inhalation, 3 cases of death from intentional isobutane inhalation, and 2 cases of death from intentional DME inhalation (Tab C). These propellants are extremely flammable and may not be suitable for all duster uses because of that flammability.

Nitrous oxide

Nitrous oxide (N_2O) has been in use as an anesthetic for nearly 200 years. It is also increasingly popular for inhalant abuse (Sagepub, 2022). Small N_2O gas canisters are used for whipped cream dispensers, from which the term “whippits” or “whippets” is derived. Inhaling N_2O from these canisters is likely popular due to its euphoric effects, low cost, and ease of access. While acute toxicity of N_2O is rare, chronic N_2O abuse can cause functional vitamin B-12 deficiency resulting in multiple neurologic deficits. N_2O abuse can increase homocysteine levels leading to venous thromboembolism.[18] N_2O abuse is associated with hallucinations, confusion, persistent numbness, and accidental injury. Accidental injury is observed with the highest number of 'hits' per session, suggesting a dose-response relationship (PubMed, 2016). CPSRMS (from 2006-2022) has 10 reported cases of death from intentional N_2O inhalation (Tab C).

Carbon dioxide

Carbon dioxide (CO_2) is used in aerosol sprays, BB guns, and as dry ice. CO_2 gas is available in small metal cartridges. The disadvantages of CO_2 for use as a propellant include the low capacity of CO_2 cartridges and a spray force that is less than that of liquid propellants.[19] In

[18] A blood clot that prevents the flow of blood in veins.
[19] The term liquid propellants refer to volatile hydrocarbons, DME, DFE, HFC-134a, and HFO.

addition, CO_2 spray force diminishes as the cartridge runs out, so the first half of the cartridge is more effective than second half (Chemtronics, 2022). Commercial CO_2 mini gas dusters[20] (a dispenser with a replaceable cartridges) as stated by the manufacturer deliver about 150-200 short half-second blasts per 16-gram gas cartridge.

The literature reported about 90 deaths per year from CO_2 exposure related to work in confined spaces and the use of dry ice (PubMed Central, 2017). CO_2 can cause asphyxiation[21] by hypoxia but also acts as a toxicant.[22] At high concentrations, CO_2 can cause unconsciousness almost instantaneously and respiratory arrest within one minute (PubMed Central, 2017). CPSRMS (from 2006-2022) has 6 reported cases of death from asphyxiation due to intentional CO_2 inhalation (Tab C).

Nitrogen

Nitrogen (N_2) gas is used as a propellant in cosmetic sprays, air fresheners, and household cleaners. The disadvantages of N_2 gas as a propellant are the same as those for CO_2. The spray force diminishes as the cartridge runs out, so the first half of the cartridge is more effective than the second half. A commercial nitrogen gas duster[23] (a dispenser with replaceable cartridges) as stated in a consumer comment about this product provides only 20 bursts per 18-gram gas cartridge (American Recording Technologies, 2002b).

Atmospheric air[24] that we breathe contains 78% N_2, however purified N_2 gas acts as a simple asphyxiant[25] (CSB, 2003). CPSRMS (from 2006-2022) and has 4 reported deaths from asphyxiation due to intentional N_2 inhalation (Tab C).

Ethane

Ethane (a colorless odorless gas with a chemical formula C_2H_6) has been also proposed as a propellant. However, ethane is a highly flammable gas forming explosive mixtures with air (CAMEO Chemicals, 2022). In confined spaces, ethane can act as a simple asphyxiant (CAMEO Chemicals, 2022). Ethane is used in blends with other propellants. CPSRMS (from 2006-2022) has 2 reported cases of death from intentional ethane inhalation (in combination with propane, methane, isobutane and butane exposure) (Tab C).

Hydrofluoroolefins (HFO)

HFO's are a new generation of refrigerants with a low potential to increase global warming. HFO chemicals are also considered for use as propellants for aerosol sprays (PubMed, 2018). Aerosol dusters with a new propellant HFO-1234ze are marginally more expensive than current retail aerosol duster products with DFE. This is likely due to being a newer technology, which has not yet been widely adopted for larger volume applications like air

[20] Eco-Friendly Carbon Dioxide Mini Gas Duster (canned air) - with 3 each — AMERICAN RECORDER TECHNOLOGIES, INC. (American Recorder Technologies, 2022a)
[21] Suffocation due to the lack of oxygen.
[22] Any toxic substance, whether man-made or naturally occurring.
[23] NITRO PRO - Lab Grade Nitrogen Gas Duster with 2 each 18 gram gas cart — AMERICAN RECORDER TECHNOLOGIES, INC. (American Recorder Technologies, 2022b)
[24] Air is not frequently used as a propellant. It has the same limitations as other gases. Air was only recently introduced in the US, and the verdict is still out.
[25] A nontoxic gas which reduces the normal oxygen concentration in breathing air leading to suffocation.

conditioning (Chemtronics, 2022). HFO-1234ze is also being considered for medical use as a propellant in pressurized metered-dose inhalers (OINDPnews, 2022). Another chemical, HFO-1234yf (2,3,3,3-tetrafluoropropene) is widely used as a refrigerant in many new cars produced in the United States and the European Union (MACS, 2017).

The abuse potential for these chemicals is unknown due to their relatively low use in consumer applications. Similarly, other effects on humans have not been reported (PubMed, 2018).

Conclusion

Health Sciences staff has concluded that currently some available chemical propellants may not be suitable for use or may provide limited benefits or diminished consumer utility in comparison to DFE in consumer aerosol duster products due to either their already known abuse potential (HFC-134a, volatile hydrocarbons, DME, and nitrous oxide), or may present limitations such as using replaceable cartridges when using them in aerosol dusters application (carbon dioxide, nitrogen, ethane blends). A new class of chemical dusters is on the market using HFO propellant with no known incidents but limited information available on the potential hazards associated with this use. The effect on humans and abuse potential for HFO are unknown, and new information may emerge in the future with the wider use of these chemicals in various applications.

It is of note that abuse similar to DFE abuse can occur for aerosol dusters using the propellant 1,1,1,2-tetrafluoroethane, or HFC-134a, which is currently being used as an aerosol duster and is popular for professional or industrial applications. CPSRMS (from 2006-2022) has 14 reported cases of death from intentional HFC-134a inhalation (some in combination with DFE exposure)(Tab C). It is also of note that staff identified substantially similar products sold as freeze sprays which should be considered in possible future rulemaking.

B. Updated Review of Incidents, Injuries and Fatalities Associated with Aerosol Dusters (Tab C)

Staff from the Hazard Analysis Division of the Directorate for Epidemiology (EPHA) prepared this review of data involving the misuse or intentional abuse of aerosol dusters. This review presents information on deaths, injuries and non-injury incidents from misusing or intentionally abusing (commonly known as *huffing* but referred to here as *inhaling* or *inhalation*) of aerosol dusters. This review also presents information on fatal incidents that were attributed to DFE toxicity, but where the specific product(s) involved were either unknown or could not be reasonably identified as an aerosol duster.

The NEISS–based injury estimates and reported incidents from CPSC's CPSRMS are from January 1, 2006 to December 31, 2022. Data collection is ongoing in CPSRMS and reporting is considered incomplete for the latest three years.[26]

This memorandum is an update to the memorandum prepared in Spring 2022 for the July 2022 staff briefing package for the aerosol duster petition. The previous analysis covered aerosol

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[26] The most recent search of the CPSC databases for incidents involving misuse or intentional abuse of aerosol duster products was conducted on April 5, 2023. Product codes searched were 1133 (Aerosol containers), 0921 (Chemicals not elsewhere classified) and 0954 (General-purpose household cleaners). Aerosol duster products are included as a sub-category of product code 0954 but may occasionally be sorted into product codes 1133 and 0921. In addition, several incidents were found under inaccurate product codes through a broader search of the CPSC databases.

duster inhalation incidents in CPSRMS from January 1, 2006 to December 31, 2020, and aerosol duster inhalation injury estimates in NEISS from January 1, 2006 to December 31, 2020.

Results

Incidents were separated into two mutually exclusive categories: duster incidents (those that involved an aerosol duster), and DFE-related deaths (fatalities where the product(s) involved were unclear or unknown, but the cause of death was DFE toxicity). Fatal incidents caused by DFE toxicity from an aerosol duster, as defined above, were exclusively sorted into the first category.

CPSRMS Incident Data (2006 – 2022)

Between 2006 and 2022, CPSC received reports for 1,210 unique incidents involving inhalation hazards from aerosol dusters (of which 99.3% or 1,201 were fatal), and separately, 1,115 unique fatal incidents involving DFE toxicity (where dusters were not mentioned, but staff notes could have been involved as a source of DFE along with other possible sources of DFE such as refrigerant abuse). If all the remaining 1,115 DFE-related deaths can be attributed to aerosol dusters, then there would be a theoretical maximum of 2,325 aerosol duster incidents (including 2,316 fatalities) reported in CPSRMS. Table 1 provides an overview of the severity of these incidents.

Table 1: Severity of Aerosol Duster Inhalation and DFE Toxicity Incidents

Incident Severity	Duster Incidents	Additional DFE Deaths (Potential Duster Incidents)
Death	1,201	1,115
Emergency Department Treatment Received	2	0
Hospital Admission	1	0
Seen by Medical Professional	1	0
Level of care not known	2	0
No Injury Reported	3	0
Total	**1,210**	**1,115**

Source: CPSRMS (2006-2022).

Figure 2 provides an overview of the distribution of the number of aerosol duster inhalation and additional fatal DFE incidents (where dusters could have been involved as a source of DFE). It should be noted that data in CPSRMS is anecdotal in nature and does not necessarily represent all incidents that have *actually* occurred. Furthermore, because data collection is ongoing, the numbers may increase, especially for the later years.

Over 80% of the aerosol duster inhalation incidents in CPSRMS since 2006 occurred between 2013 and 2022. Similarly, around 84% of the deaths attributed to DFE toxicity in CPSRMS since 2006 occurred between 2013 and 2022.

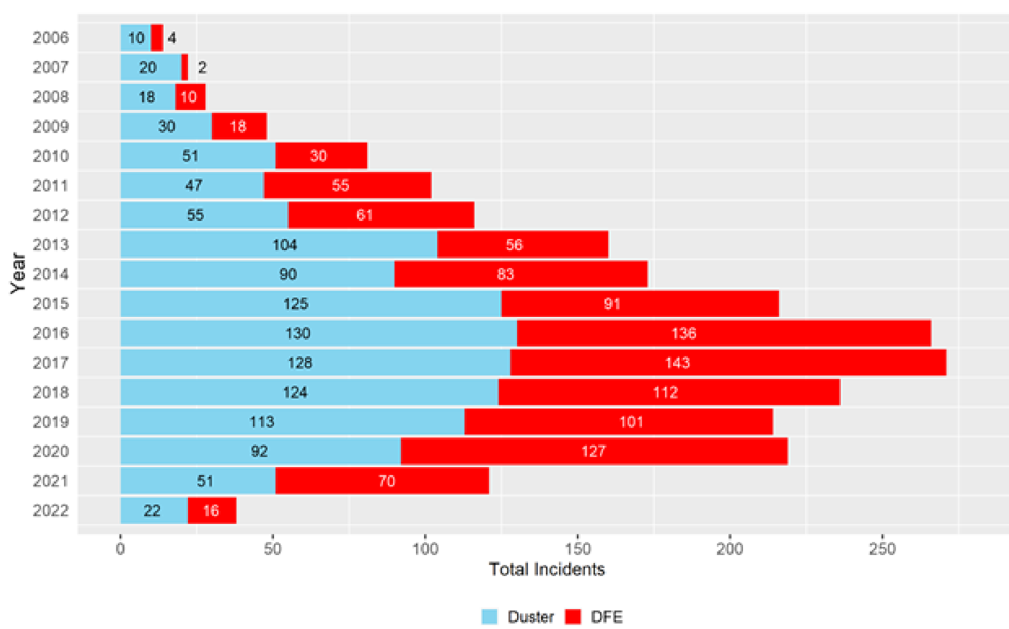


Figure 2: Fatal Aerosol Duster Inhalation and Additional Fatal DFE Incidents Reported by Year. Source CPSRMS (2006-2022)

Table 2 provides an overview of the distributions of aerosol duster inhalation and DFE toxicity victims by age group and gender. Among the aerosol duster inhalation victims, almost 70 percent of the victims were male, and over 92 percent of victims were between the ages of 18 and 54, with victims ranging between 13 and 70 years old. The fatal DFE-related incidents followed a similar distribution, with around 70% of victims being male, 95% of victims being between the ages of 18 and 54, and victims ranging between 8 and 70 years old.

Table 2: Distribution of Aerosol Duster Inhalation Victims by Age Group and Gender

Age Group (Years)	Duster Deaths			DFE-Related Deaths		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
0 – 17*	12	14	**26 (2%)**	11	3	**14 (1%)**
18 – 34	347	181	**528 (44%)**	325	147	**472 (42%)**
35 – 54	427	162	**589 (49%)**	408	174	**582 (52%)**
55 or older*	43	14	**57 (5%)**	34	13	**47 (4%)**
Unspecified	1	0	**1(<1%)**	0	0	**0**
Total	**830 (69%)**	**371 (31%)**	**1,201**	**778 (70%)**	**337 (30%)**	**1,115**

*The minimum victim age in the data was 8 years, while the maximum was 70 years.
Percentages may not add to 100% due to rounding.

The states with the most aerosol duster inhalation incidents received are Florida, Texas, California, Georgia and Illinois. The states from which the most DFE-related death reports were received are Florida, Ohio, Pennsylvania, Illinois and North Carolina. Overall, the states with the most CPSRMS reports included in this analysis are Florida (222), Texas (121), Illinois (115), Ohio (105), Pennsylvania (105) and North Carolina (105). Due to the anecdotal nature of CPSRMS data and lag time between the date of death and when it is reported to CPSC, these counts should not be used to calculate death/incident rates by state.

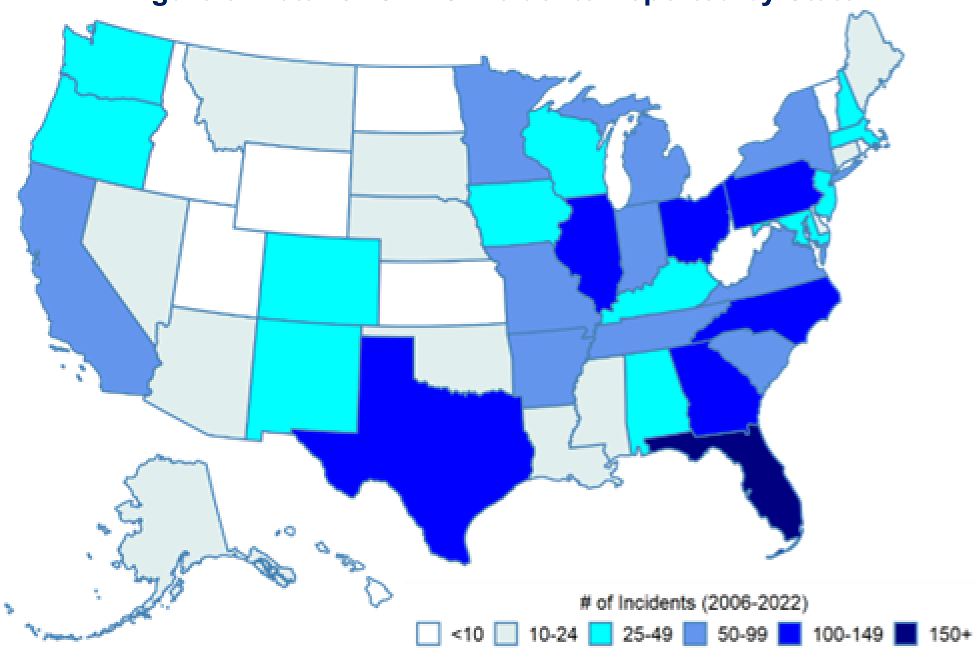
Although the majority of incident narratives did not provide detailed information on the victim or the incident circumstances, the following observations were made based on keywords in the more descriptive incident narratives concerning duster incidents and additional DFE deaths where the narratives did not specify a product:

- In 133 duster incidents the aerosol duster inhalation victim had a history of previous use of inhalants (including dusters), drugs or alcohol or was simultaneously using drugs or alcohol.
- In 114 DFE-related deaths, the aerosol duster inhalation victim was simultaneously using, or had a history of using inhalants (including aerosol dusters), drugs or alcohol.
- In 34 duster incidents and 8 DFE-related deaths, the victim had a previous history of depression or other underlying mental conditions.
- In 60 duster incidents, all fatal, and 52 DFE-related deaths, the victim was reported to have died from drowning, or was found fully or partially submerged in water, usually a bathtub or a pool.

- In 20 duster incidents and 15 DFE-related deaths, the victim was found in a vehicle, or found operating a vehicle. 19 of the 20 duster incidents resulted in deaths, while one required emergency department treatment of the victim.

Figure 3 provides an overview of the distribution of *total* CPSRMS incidents (duster inhalation and DFE-related deaths) by U.S. state.

Figure 3: Total CPSRMS Incidents Reported by State



NEISS-based National Injury Estimates (2006 – 2022)

Staff analyzed NEISS-based incidents, and only included cases in the sample if the product being used reasonably could be classified as an aerosol duster.[27] While CPSRMS incidents typically report a product's identifying characteristics (i.e., manufacturer, brand, model, retailer, product description), NEISS narratives rarely provide such detailed information on the products involved. As such, the NEISS statistic is likely an underestimate of the number of injuries from inhalation of aerosol dusters. An additional 2,700 ED-treated estimated injuries resulted from inhalation products described as "aerosol cans", "aerosol cleaners", or simply "aerosols," but these injuries are excluded from this analysis because of the non-specificity of the product description and the lack of information on the propellant being inhaled (e.g., DFE).

Table 3 presents a breakdown of the disposition of the injured patients. A large majority (71%) of the estimated injuries were categorized as "treated and released" or "examined and released

[27] Keywords used to identify products in CPSRMS and NEISS included: inhalation, inhaling, sniffing, duster, aerosol duster, computer cleaner, keyboard cleaner, computer duster, keyboard duster, electronic duster, compressed air, canned air and specific brand names. Variations and combinations of these keywords were also used to capture misspellings or variations in how the product was identified.

without treatment," while around 20% involved more serious injuries requiring hospitalization or additional observation.

Table 3: NEISS Estimates for Aerosol Duster Inhalation Injuries by Disposition

Disposition	Estimate	Sample Size
Treated and released, or Examined and released without treatment	20,300 (71%)	446
Treated and admitted for hospitalization, or Held for observation	5,800 (20%)	135
Left without being seen, or Left without treatment	2,400 (8%)	52
Death	** (<1%)	5
All Severities	**28,800**	**638**

Source: NEISS (2006-2022).
Estimates rounded to nearest 100; estimates that failed to meet NEISS publication criteria are presented as **.
Rows may not add to total due to rounding.

Table 4 presents an overview of the injuries based on age and gender. Around 63% of the estimated injuries occurred in males, and around 86% of estimated injuries occurred in patients between ages 18 and 54.

Table 4: NEISS Estimates for Aerosol Duster Inhalation Injuries by Age & Gender

Age Group (Years)	Male	Female	Total
0 – 17	2,000	1,700	**3,600 (13%)**
18 – 34	8,600	4,200	**12,800 (45%)**
35 – 54	7,500	4,200	**11,700 (41%)**
55 or older	**	**	**** (2%)**
Total	**18,200 (63%)**	**10,500 (37%)**	**28,800**

Source: NEISS (2006-2022).
Estimates rounded to nearest 100; estimates that failed to meet NEISS publication criteria are presented as **.
Rows may not add to total due to rounding.

Approximately 24,800 of the ED-treated estimated injuries (86%) were diagnosed primarily as poisonings, while the remaining 4,000 estimated injuries were diagnosed mostly as burns (chemical, thermal or unspecified), anoxia, contusions/abrasions, lacerations, or internal organ injuries.

Approximately 25,100 of the ED-treated estimated injuries (87%) were considered "whole body" injuries (i.e., no specific individual body part injured as a result of inhalation). Another 2,100 estimated injuries (7%) were classified as head, face or mouth injuries, while the remaining 1,600 estimated injuries (5%) were mostly classified as hand, lower arm or upper trunk injuries.

Consistent with the assertion made by the petitioner that aerosol duster abuse is associated with "auto accident fatalities where inhaling drivers hit pedestrians or other drivers," readily available information from NEISS suggest dusters are abused/huffed in cars and while driving.

Approximately 2,600 ED-treated estimated injuries (9%) involved the use of an aerosol duster in a motor vehicle.

C. Aerosol Duster Petition: Alternative Mechanical Designs (Tab D)

Introduction

This memorandum discusses mechanical aerosol actuator designs that could prevent users from intentionally inhaling and abusing DFE or other toxic propellants found in aerosol duster products.

DFE is a common propellant used in aerosol duster products. DFE can be compressed into a liquid at a relatively low pressure at room temperature. The aerosol canister contains DFE in both liquid form and gas form. After each burst of DFE gas released from the aerosol canister, a portion of the liquid DFE boils off and converts to a gas to maintain pressure within the canister. This process allows for consistent burst strength and longtime use of a single canister.

Actual air is not used in an aerosol canister because it is not practical for the common design of aerosol canisters currently sold. A canister filled with compressed air will only last for a few short bursts and lose burst strength in a short time. To use a liquid/air combination, such as how DFE liquid/gas is used in aerosol dusters, would be impractical given the extreme pressure and temperature requirements to create this liquid/air combination. One alternative on the market is refillable spray dusters which use a Schrader valve (valve commonly found on automobile tires and some bicycle tires) to fill a canister to 200 psi, as shown below in Figure 4. This alternative would require either an air compressor or a manual air pump in order to refill it as needed.

Figure 4: Refillable compressed air canister.

Another alternative design on the market currently is replaceable cartridge designs which use commonly available disposable CO_2 cartridges of various sizes, as shown below in Figure 5.

Figure 5: Replaceable CO_2 cartridge.

Discussion

Currently, aerosol dusters use different actuator designs. Figure 6 below shows two examples currently in use. The nozzle orifice of the actuator is a protrusion with an opening from which the DFE gas is released. In order to spray the DFE gas, the user needs to press on the trigger.

Figure 6: Current common aerosol single trigger actuator designs.

These actuator designs do not have a trigger locking mechanism that prevents product users from intentionally inhaling and abusing the DFE within.

Aerosol actuator designs do exist which are equipped with locking features to prevent an accidental discharge of the duster. Figure 7 below shows a twist to lock/unlock design. The user can twist portion 510 about base 590 to either lock or unlock the trigger.

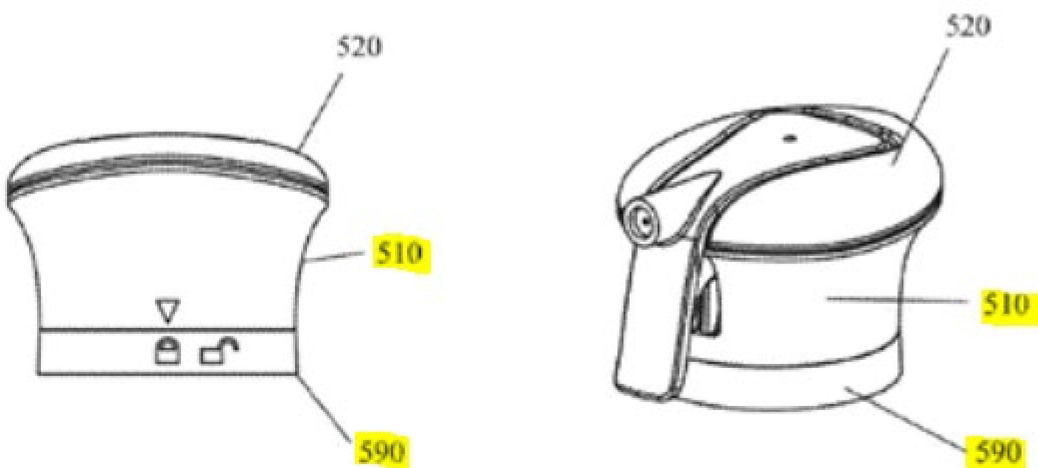


Figure 7: Twist to lock/unlock aerosol actuator design.

Another aerosol actuator design uses a straw to lock the trigger shown in Figure 8 below.

Figure 8: Straw lockout design.

Aerosol actuator lockout designs shown in Figures 7 and 8 are effective in preventing users from accidentally pressing the trigger while aerosol duster canisters are in storage. However, they are not effective in preventing users from intentionally inhaling and abusing the DFE. There are dual trigger designs where two independent triggers must be pressed simultaneously in order to spray aerosol contents. Figure 9 below is an example of this design where both triggers 160 and 158 must be pressed simultaneously.

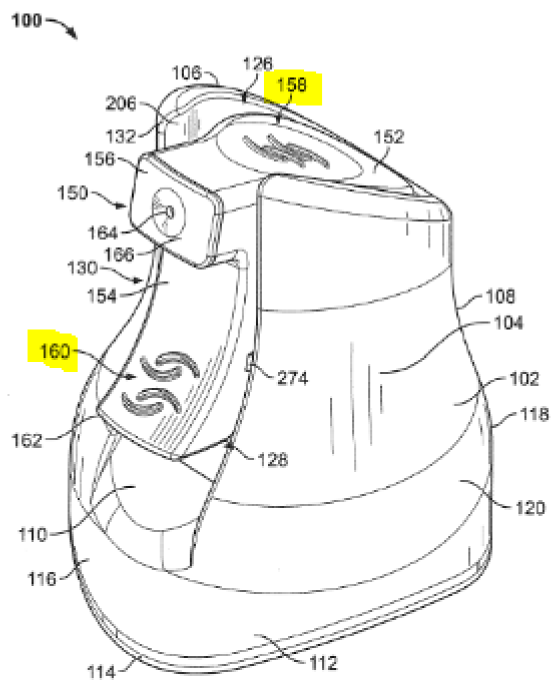


Figure 9: Dual trigger design.

While dual trigger designs may be effective in preventing accidental spraying of the contents while in storage or prevent young children from accidental usage, they are not effective in preventing teenaged and adult users from intentionally inhaling and abusing the DFE from an aerosol duster.

Another possible design concept is modifying the trigger so that, when activated, only a short burst of the DFE is dispensed per activation. This trigger design can be locked by a timing device to prevent multiple bursts over a certain time period. While this trigger design may be helpful in the prevention of inhaling DFE and the abuse of a single aerosol duster, it may not be effective when there are multiple aerosol dusters available to the user. Further, this would likely reduce the utility of the aerosol duster when it is used for dusting by preventing dusting users from using their aerosol duster as often or as long as intended.

Another conceptual design would be to have a lockable lid on the aerosol duster. Figure 10 below shows a sketch of an example where an aerosol duster would have a lid with an integrated locking device or a supplied padlock and key to prevent unauthorized use by others. The locking device would need to meet design requirements to prevent users from breaking the locking device. These design requirements would be dependent on the specific age range that owners are trying to prevent access to the product.

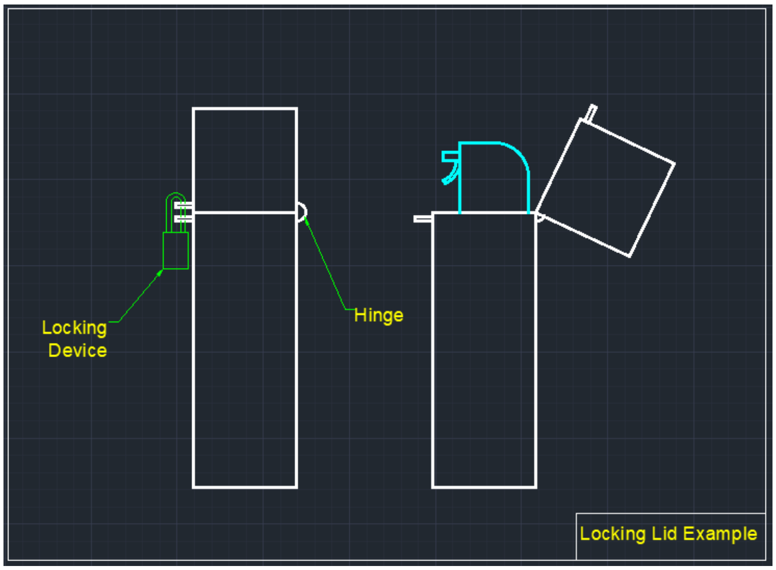


Figure 10: Concept of a pad lockable lid design.

This design may be useful in some situations such as parents preventing teenagers from abusing aerosol dusters. However, this locking feature can be defeated with the use of basic tools. There is also nothing preventing teenagers or other adults from purchasing any other aerosol dusters in store or online.

Several alternative products to aerosol dusters exist. (Cost comparisons of duster products are contained in Economics Directorate memorandum TAB E.) Figure 11 below shows an example of a battery operated and USB rechargeable device that blows air. It has several attachments that can be used for cleaning multiple surfaces and is a single device option serving as an alternative to purchasing multiple aerosol dusters.

Figure 11: Battery operated air blowing device.

A similar alternative product is shown below in Figure 12. This model is also battery operated and USB rechargeable. However, this model offers both a blower mode and an additional vacuum mode so the user can choose between blowing contaminants away or vacuuming them up.

Figure 12: Battery operated air blowing & vacuuming device.

Another possible alternative to aerosol dusters is to modify a 'Bag on Valve' (BOV) aerosol system. Currently, BOV canisters are used to spray a material formula such as liquid, gel or other ointment that is completely separated from the propellent gas. This is made possible by keeping the material formula contained within a bag and the bag contained within a canister surrounded by a propellant gas which squeezes the bag, shown below in Figure 13.

Figure 13: Visual of a BOV system.

This design could be modified to incorporate a DFE liquid/gas mixture as the contained propellent and use compressed air as the formula sprayed out. This design would have an advantage of maintaining the blowing force of the compressed air over time because the DFE boils off as the product is used. The DFE in this design concept would be contained and prevent access to the user and thus would be helpful in preventing intentional abuse and inhalation. However, the lifetime use of this design would still be limited and dependent on the size of the canister and the bag within the canister. A typical aerosol duster canister of DFE would last much longer because DFE has the advantage of existing as a liquid and gas within the canister.

A further modification of the BOV system above would be to allow refilling of the bag using a check valve with compressed air as needed. While containing the propellent DFE within the canister a user would only need to refill the bag using an air compressor or air pump via the check valve. This conceptual design is not currently an available product, but it would allow a single canister to be reusable. However, the lifetime of each refill will be limited based on the size of the bag containing compressed air.

Testing

Testing of Refillable Air Can

Laboratory Sciences Mechanical (LSM) engineering staff acquired a 24 ounce (oz) refillable air canister having a Schrader valve and spray outlet diameter of 2.0 mm. While this canister has a maximum pressure of 200 psi (pounds per square inch), staff filled it to 100 psi for testing. The goal was to observe how many single second bursts the 24 oz canister could supply. It was found to produce 4-5 single second quality bursts before weakening at 20 psi remaining and needing refilling. If filled to the maximum 200 psi, the canister would likely produce 8-10 single second quality bursts before also weakening at 20 psi and needing refilling with either an air compressor or manual air pump.

If this same refillable 24 oz canister were instead a refillable BOV system, staff estimates that along with maintaining burst strength, the 20 psi remaining in a refillable canister could be used to produce an extra 1-2 single second bursts.

Testing of Battery-Operated Devices for Air Speed

Staff acquired battery operated and USB rechargeable duster devices. The goal was to compare air speeds, measured in meters/second (m/s), generated by the battery powered devices to the speeds generated by an aerosol duster. Three battery powered devices and two name-brand aerosol dusters were chosen for comparison.

Tables 5 and 6 below provide relevant information and specifications of each product.

Table 5: Information and Specifications of The Battery Powered Devices

Battery Powered Device	Battery Size (mAh)	Motor Speed (RPM)	Advertized Run Time (min)	Tested Nozzle Length (in.)	Tested Nozzle Orifice Diameter (in.)
Device #1	7600	91,000	Not Provided	2.75	0.25
Device #2	6000	3500	30	5.25	0.30
Device #3	6000	33,000	30	4.13	0.30

Table 6: Information and Specifications of The Aerosol Dusters

Aerosol Duster Brand	Net Weight (oz)	Tested Nozzle Length (in.)	Tested Nozzle Orifice Diameter (in.)
Brand #1	10	4.00	0.05
Brand #2	10	5.00	0.05

Testing of the battery powered devices was performed with the nozzle orifice located 6 in. away from a REED LM-8000 anemometer which was calibrated during its manufacturing process at an ISO-9001 facility. The devices were set to their maximum speed setting and allowed to run for 30 seconds while the anemometer was set to record the maximum and minimum air speed generated. Table 7 below shows the performance results of each device.

Table 7: Battery Powered Devices Performance Results, Within 30 second Time Frame

Battery Powered Device	Air Speed Max (m/s)	Air Speed Min (m/s)
Device #1	15.9	13.9
Device #2	12.2	10.5
Device #3	15.8	14.7

The results in Table 7 show each device maintained an air speed of no more than 2 m/s below the recorded maximum air speed over the 30 second time frame. This would be expected considering the motor's speed measured in revolutions per minute (RPM) would be maintained at a constant speed. Device #2, having a lower motor RPM of 3500 did not perform as well as the other two devices which each had a greater motor RPM of 91,000 and 33,000.

Testing of Aerosol Dusters for Air Speed

For the aerosol dusters, the testing was also performed with the nozzle orifice located 6 in. from the REED LM-8000 anemometer. Starting with a full canister, the trigger was pressed and held for 10 seconds while the anemometer was set to record the maximum and minimum speed. This test was repeated for each canister at 75% full, 50% full and 25% full. After recording the maximum and minimum air speeds at 75%, 50% and 25% full, each aerosol duster was allowed to sit for 10 seconds and then the trigger was pulled for an additional 10 seconds to have another maximum and minimum air speed recorded (See Tab D for more detail). Table 8 below shows the performance results of each aerosol duster.

Table 8: Aerosol Duster Performance Results, at 10 second Intervals

Aerosol Duster Brand	Air Speed Max (m/s)	Air Speed Min (m/s)	Additional 10s Air Speed Max	Additional 10s Air Speed Min (m/s)
Brand #1 (Full)	17.4	10.7	--	--
Brand #2 (Full)	16.2	11.8	--	--
Brand #1 (75% Full)	16.7	10.5	10.2	6.1
Brand #2 (75% Full)	15.7	10.0	9.1	5.5
Brand #1 (50% Full)	16.5	11.4	10.8	5.8
Brand #2 (50% Full)	14.0	9.7	9.5	5.1
Brand #1 (25% Full)	16.4	9.9	8.0	4.3
Brand #2 (25% Full)	14.1	7.8	7.7	3.5

Note: In the table above, “--" indicates not tested.

The results in Table 8 show that when an aerosol duster is given time to have its liquid DFE boil into gas form and return to optimum pressure, the maximum air speed performance does not lessen over its lifetime. A 25% full aerosol duster still generates an air speed of only 1.0-2.5 m/s less than a full one. However, the results show that the air speed decreases over the length of time the trigger is held per use. This is expected because the liquid DFE cannot boil fast enough to maintain the pressure within the aerosol duster. The instructions on aerosol dusters typically instruct the user to use only in short bursts in order maintain burst strength.

When comparing the performance results of battery powered dusters vs. aerosol dusters, the initial maximum air speeds (Air Speed Max (m/s)) measurements are comparable. Aerosol dusters tend to generate a slightly higher air speed, over short periods of time. However, a drawback to aerosol dusters is their long-term performance in a single use. The battery-operated duster designs can generate and maintain air speeds of 10-16 m/s over the life of the battery while the aerosol dusters produce usable air speeds for shorter periods of time and need time to allow their liquid DFE contents to boil into gas after 10-20 seconds of use in order to reach their max air speed potential.

A second drawback of aerosol dusters is their longevity. Because the battery powered dusters can be recharged, they can potentially last for years of use. Whereas an aerosol duster has a limited amount liquid DFE and is designed for single use after which it is recycled or disposed of as solid waste. Therefore, aerosol dusters do not have the same longevity as battery powered dusters and multiple aerosol dusters are needed for continued use. Accordingly, the cost of a single battery powered duster device may be more cost effective than the purchase of multiple aerosol dusters over time (See Economics Directorate memorandum TAB E).

Testing of Aerosol Dusters Trigger Pulls: Quantity Release (20 grams)

LSM staff also created a test to determine how many trigger pulls it takes to release 20 grams of DFE. Twenty grams was chosen from a case in which the driver of a vehicle in an accident was found with two aerosol dusters: one unopened and the second weighing 20 grams less.[28] Two of a name-brand aerosol duster were used for the test where one was tested with the straw and the other was tested without the straw.

After letting the aerosol dusters sit for 4 hours, each trigger was pulled for 5 seconds. They were then weighed before immediately pulling the trigger again for 5 seconds. This process was repeated until at least 20g were removed.

Table 9: Number of 5 second Trigger Pulls to Remove 20 grams

	Test Results Using Straw	Test Results Not Using Straw
Starting net Weight DFE (grams)	261.3	258.8
Number of 5 Second Bursts	6	3
Final DFE Weight (grams)	240.2	236.2
Avg Burst (grams)	3.52	7.53

The results in Table 9 show that an abuser can inhale 20g of DFE from an unused canister with only three trigger pulls of 5 seconds each.

Mechanical Design Conclusions

Staff concludes that because fatal incidents almost entirely involve teenagers and adults, that it is not feasible to address the hazard via lockout devices. The lid and trigger designs for aerosol dusters currently on the market are locking mechanisms intended to prevent accidental spraying and to keep young children from activating the trigger but are not effective for denying access to abusers of the product.

Staff concludes that battery powered air duster devices generate comparable air speeds to the propellant speeds of aerosol dusters.

Results from testing quantities released from aerosol duster trigger pulls indicate that an abuser may inhale 20 grams of DFE from a single aerosol duster in three 5-second trigger pulls. However, during testing, each aerosol duster was allowed to sit for a period of time before repeating the trigger pull test measurement. Therefore, the test method employed may overstate actual intoxicating DFE dose for an aerosol duster.

[28] Tiscione, N. B., & Rohrig (2021). Journal of Analytical Toxicology; 1,1-Difluoroethane Forensic Aspects for the Toxicologist and Pathologist; 45:792–798.

D. Market and Economic Considerations for Petition Requesting the Commission Initiate Rulemaking to Adopt a Mandatory CPSC Safety Standard to Address the Hazards Associated with "Duster" Aerosol Products (Tab E)

The Commission Directive Implementing Procedure 302 for Petitions requires the Directorate for Economic Analysis to provide preliminary information on the following:

- A brief discussion of market information. Staff will provide data on sales, product use, the number and size of firms, an estimate of product life, and the number of products in-use using readily available information from government, industry, or other sources.

- A preliminary estimate of the annual cost to society of the hazard, if accurate information is readily available. Estimates of the annual societal cost include estimates on injuries from the CPSC injury cost model and other sources, property damage, and an assumed value per statistical life.

Accordingly, this memorandum provides information on the U.S. market for aerosol duster products and a preliminary estimate of the annual cost to society of the hazard associated with the products.

Market

To better understand the market for aerosol dusters, CPSC staff sponsored a contract to gather, update, or develop key market data for the aerosol duster market, to inform future decision-making regarding rulemaking. The contractors will draft a report of their findings, titled the ADP Market Report. The contractors will complete their work in July 2023, at which time the ADP Market Report can be made available.[29]

In this memorandum, staff provides readily available information and draft findings of the ADP Market Report, including information on sales, product use, the number and size of firms, an estimated product life, and the number of products in use.

Aerosol Duster Description

Size. Aerosol dusters for consumer use are typically sold as a 10 oz. can with a trigger nozzle head. Aerosol dusters are also sold by retailers in 3.5 oz., 8 oz., and 17 oz. sizes.

Propellant. An aerosol duster contains a propellant that is used to clean dust and debris from keyboards, electronics, or other items. The propellant in the can exists in an equilibrium between liquid and gas phases and is released as a gas. According to aerosol duster Safety Data Sheets,[30] difluoroethane (CAS No. 75-37-6), also known as DFE or HFC-152a, is the most

[29] Data from the ADP Market Report will include information on aerosol duster products that use DFE and alternative propellants, in-store and online product audits, and primary interviews from trade and industry experts.
[30] The Occupational Safety and Health Administration's Hazard Communication Standard (29 CFR 1910.1200(g)) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets for hazardous chemicals to downstream users
(https://www.osha.gov/sites/default/files/publications/OSHA3514.pd

commonly used propellant in consumer aerosol dusters.[31] The second most commonly used propellant in aerosol dusters is 1,1,1,2-tetrafluoroethane (CAS No. 811-97-2), also known as HFC-134a, which can be used alone or in mixture with difluoroethane. HFC-152a and HFC-134a are hydrofluorocarbon propellants.[82] A third propellant that is less commonly used, trans-1,3,3,3-tetrafluoropropene (CAS No. 29118-24-9), is also called HFO-1234ze.[32]

Marketed Uses

Producers design and intend aerosol dusters to be used for multiple purposes by consumers. Many aerosol dusters are labeled for "electronics dusting," or more generically, as a "multi-purpose duster." Aerosol dusters are marketed for dusting laptops, keyboards, computers, TVs, phones, printers, electronic toys, gaming devices, and other common household electronic products. Aerosol dusters can be sold for other household uses such as the removal of dust or debris from sewing machines, clocks, watches, musical instruments, or auto detailing.

Manufacturers and distributors of aerosol dusters may also provide similar products marketed for a different use that also use DFE as a propellant. For example, Falcon Safety Products, a manufacturer and supplier of aerosol dusters, also manufactures and sells a product called "Sound Alert." The product is a 6 oz. can containing DFE (CAS No. 75-37-6) used as a hand-held signaling device.

Similarly, manufacturers and distributors of aerosol dusters may also provide products that use a propellant, such as HFC-134a (CAS No. 811-97-2), that are used for cooling electronics. For example, Chemtronics, a manufacturer and supplier of aerosol dusters, also distributes "freeze spray" in a 10 oz. canister with a trigger head that is used to cool electronic components like circuit boards.

Market Information

Aerosol dusters are available for purchase from a variety of in-store and online retail locations, including office-supply stores, hardware stores, home-electronics stores, auto-supply stores, grocery stores, and pharmacies.

Display and Restrictions. In retail stores, aerosol dusters for consumer use are available on shelves, typically in the consumer electronics section. Aerosol dusters are also found in locked shelves or behind the counter, where a sales associate must assist the consumer to access the product in store. In various U.S. States, aerosol dusters may be restricted for sale to consumers over age 18 and must present a valid form of identification.[33] Online, consumers may be asked to verify they are age 18 or older before purchasing an aerosol duster.

Product life. Aerosol dusters are sold without an expiration date printed on the canister and may have a relatively long shelf life. According to preliminary data collected for the ADP Market Report, the product warranty may be limited to 1 year.

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[31] Safety Data Sheets do not typically specify the exact concentration of propellant used alone or in mixture in aerosol duster products.
[32] HFO-1234ze was introduced by industry within the past ten years and is advertised as an eco-friendly alternative in consumer aerosol duster products, with "ultra-low Global Warming Potential (GWP)." (TechSpray, 2023)
[33] This information was collected by staff through in-person and online store audits.

Sales. In the previous July 2022 staff briefing package submitted to the Commission, staff estimated that approximately 20 million canisters of aerosol duster products are sold each year and that industry sales are approximately $160 million per year. Staff derived this estimate by analyzing revenues of market-leading firms with information from the Household & Commercial Products Association (HCPA) annual survey of aerosol pressurized products. Preliminary information collected for the ADP Market Report confirmed these estimates correctly approximate the size of the U.S. market for aerosol dusters. However, at the time this memorandum was written, the ADP Market Report had not yet been finalized.

Aerosol dusters are sold in aerosol cans. HCPA estimates that 3.75 billion aerosol cans were filled in the United States in 2020.[85] If 20 million cans of aerosol dusters are produced and sold each year, aerosol duster production would represent less than one percent of the total number of aerosol cans produced each year.

Number and Size of Firms. Preliminary data from the ADP Market Report identifies 22 suppliers of aerosol dusters. The majority of these firms would be considered small, according to Small Business Association (SBA) guidelines.[34]

In the July 2022 staff briefing package for aerosol dusters staff in the Directorate for Engineering Sciences, Division of Human Factors (ESHF) concluded that a warning label alerting consumers to the hazard of intentionally abusing aerosol dusters could lead to the very behavior the label is intended to protect against. Upon review of the preliminary information available from the draft ADP Market Report, ESHF staff did not identify any new information that would contradict their previous conclusion. In consultation with staff in the Directorate for Economic Analysis, ESHF staff find that the development of a performance standard for warning label language or warning label placement would not have a significant impact on the misuse or abuse of aerosol dusters.

Competing Products and Substitutes

According to readily available data retrieved from the internet in July 2022[35] and March 2023,[36] electronic air dusters consistently compete with aerosol dusters as “the best-selling compressed air dusters.” Electronic compressed-air dusters are advertised as an alternative to aerosol dusters, suitable for cleaning electronics, with a variety of additional product functions depending on the model including:

- Strong, non-diminishing, air flow that can be used for dusting for long periods
- Rechargeable, for repeated use
- May provide both a blown-air and vacuum air function
- Adjustable settings (e.g., high, medium, and low) for greater control
- May come with brushes and nozzles as attachments for cleaning
- May include a light to illuminate the area or electronics being cleaned
- Can be used to inflate other products, such as air mattresses

According to online product reviews, electronic compressed-air dusters are typically more expensive than aerosol dusters. However, while the up-front cost of purchasing an electronic compressed-air duster is initially higher, over the product lifespan, it could result in a net savings

[34] https://www.sba.gov/document/support-table-size-standards
[35] https://www.amazon.com/Best-Sellers-Compressed-Air-Dusters/zgbs/pc/3012916011 (visited 5 July 2022).
[36] https://www.bestreviews.guide/compressed-air-dusters-for-computers (visited 22 March 2023).

compared with regular and repeated purchasing of disposable single-use aerosol dusters. Electronic compressed-air dusters may also be preferred by consumers because of the lack of propellant and their ability to provide continuous, strong, and non-diminishing blown air.[37] However, some product reviewers note that electronic air dusters can be loud.

Societal Costs of Aerosol Dusters

The Commission Directive Implementing Procedure 302 for Petitions requires the Directorate for Economic Analysis to provide a preliminary estimate of the annual cost to society of the hazard. Estimates of the annual societal cost presented below include estimates on injuries from the injury cost model (ICM) and fatalities at an assumed value per statistical life (VSL).
The total cost to society from aerosol duster injuries and fatalities is estimated to range from $1.031 billion to $1.837 billion per year.

- The estimated annual cost to society from fatalities ranges from $868 million to $1.674 billion per year.
- The estimated annual cost to society from injuries is greater than $163 million per year.

Evaluating the total societal costs across approximately 20 million cans of aerosol dusters sold every year results in an estimated societal cost ranging from $50 to over $90 per can.

Other Costs

The estimated annual cost to society of the hazard should include estimates on injuries from other sources and property damage. Consistent with the assertion made by the petitioner that aerosol duster abuse is associated with “auto accident fatalities where inhaling drivers hit pedestrians or other drivers,” NEISS data suggest aerosol dusters are abused in cars and while driving. Specifically, CPSC staff estimate 2,600 ED-treated injuries involved the use of an aerosol duster in a motor vehicle, from 2006-2022. (See Tab C.)

ICM cost estimates of the available data do not include property damage. Data reviewed from NEISS and CPSRMS only involve the injuries and fatalities of aerosol duster abusers, and therefore may underestimate the societal cost of the hazard.

Available data underestimate the cost of:

- injuries and fatalities to bystanders, pedestrians and other drivers
- private and public property damage, such as damage to other vehicles, and roadway structures (e.g., walls, medians, mailboxes, etc.)

In the June 2021 petition, the petitioner provides a list of huffing cases reported in the local news.[38] The petitioner identified fourteen incidents across the country of huffing between May 21, 2018, to July 11, 2018. Nine of the cases identified by the petitioner involve a parked car or a car in motion.

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[37] Propellant can sometimes leak from aerosol dusters onto computer electronics. The blast of ‘air’ from an aerosol duster will diminish. For these reasons, product reviewers note that electronic compressed-air dusters are preferable to aerosol dusters because they will not leak propellant and can maintain a steady air flow.
[38] https://www.regulations.gov/document/CPSC-2021-0015-0002

Anecdotal data provided by the petitioner reflect incident narratives available from NEISS Data collected by CPSC, between 2006 and 2020. Though not captured in the available injury and fatality data, costs for bystanders struck by abusers of aerosol dusters while operating a motor vehicle, could be significant. Property damage to high-priced items, like motor vehicles, may also be substantial, but is likely smaller than the cost in life.

Conclusions

The three most commonly used propellants in aerosol dusters are HFC-152a (DFE), HFC-134a (1,1,1,2-tetrafluoroethane), and HFO-1234ze (trans-1,3,3,3-tetrafluoropropene). If products with a different propellant, such as HFC-134a (1,1,1,2-tetrafluoroethane, CAS No. 811-97-2), were excluded from the scope of a future rulemaking, and if those products presented a similar addiction hazard that created a similar pattern of death and injury, any hazard reduction benefits of the rule would be limited as manufacturers could change the formulation of the product to be outside the scope of the rule. Similarly, if products such as freeze sprays which are essentially the same in content as dusters are not included in scope, they could be used interchangeably with the same expected results.

ICM cost estimates of the available data do not include property damage. Data reviewed from NEISS and CPSRMS only involve the injuries and fatalities of aerosol duster abusers, and therefore may underestimate the societal cost of the hazard.

The total cost to society from aerosol duster injuries and fatalities is estimated to range from $1.031 billion to $1.838 billion per year, with an estimated cost of $50 to over $90 per canister produced. The estimated annual cost to society from fatalities ranges from $868 million to $1.674 billion per year. The estimated annual cost to society from injuries is greater than $163 million per year.

E. Voluntary Standards

The ASTM International standards organization initiated an exploratory call regarding aerosol dusters in February 2023. ASTM has not decided if a voluntary standard will be developed.

IV. Staff's Assessment of Commission Options

The Commission may grant the petition, deny the petition, or defer action on the petition. The Commission considers several factors relevant to the Commission's decision in granting or denying a petition, which staff considered while assessing these options. Relevant considerations include whether the product involved presents an unreasonable risk of injury, whether a rule is reasonably necessary to eliminate or reduce the risk of injury, whether failure of the Commission to initiate a rulemaking proceeding requested would unreasonably expose the petitioner or other consumers to the to the risk of injury which the petitioner alleges is presented by the product, the relative priority of the risk of injury, and the Commission's resources available for rulemaking activities with respect to that risk of injury. 16 C.F.R. § 1051.9.

A. Grant the Petition

Granting the petition to begin rulemaking would allow staff to develop a notice of proposed rulemaking briefing package to address the unreasonable risk of injuries and deaths due to inhalant abuse of aerosol dusters.

Granting a petition does not require the Commission to issue a rule under the authority cited in the petition. In addition, granting a petition does not require the Commission to issue a rule in the specific form requested by the Petitioner. 16 C.F.R. § 1051.10(b).

B. Deny the Petition

Denying the petition would preserve limited CPSC resources, making those resources available to address priorities for other hazards that could be addressed more effectively by rulemaking. The resources required to review data, evaluate performance requirements, and conduct economic analyses necessary to develop a rule would require significant staff commitments. "A Commission denial of a petition shall not preclude the Commission from continuing to consider matters raised in the petition." 16 C.F.R. § 1051.11(c).

C. Defer Action on the Petition

If the Commission concludes that more information is required before it can decide whether to grant or deny the petition, the Commission may defer a decision and direct staff to collect additional information and reconsider the petition after that work is completed. Deferring the petition would enable staff to reallocate resources from other priorities and conduct further research into issues related to death and addiction from abuse of aerosol duster products to inform potential ways to address these hazards.

V. Staff's Recommendation and Conclusion

In a July 2022 briefing package, staff concluded that the Petitioner's proposed recommendations to use a bitterant and to require an enhanced warning label would not be effective in adequately mitigating the risk of death from inhalation of aerosol duster products. As discussed in this staff briefing package the health risks that that are presented from inhaling aerosol duster products are very serious and include the risk of injury and death. Between 2006 and 2022, CPSC received reports for 1,210 unique incidents involving inhalation hazards from aerosol dusters, and an additional, 1,115 unique fatal incidents involving DFE toxicity. An overwhelming majority (99.3%) of the aerosol duster inhalation incidents in CPSRMS reported between 2006 and 2022 resulted in deaths. Between 2006 and 2022, it is estimated that there were 28,800 ED treated injuries resulting from inhalation of aerosol duster products in the United States. This estimate is based on a sample of 638 NEISS injury cases. The total cost to society of injuries and fatalities associated with aerosol dusters is estimated to range from $1.031 billion to $1.837 billion per year, with an estimated cost of approximately $50 to over $90 per canister produced.

Based upon the information in the staff briefing package, staff recommends that the Commission grant the petition and direct staff to develop a notice of proposed rulemaking briefing package to address the unreasonable risk of injuries and deaths due to inhalant abuse of aerosol dusters. Staff also recommends future rulemaking to consider aerosol freeze sprays that consist of approximately 100% propellant in a pressurized spray can, which provide essentially the same delivery system as aerosol dusters.

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TAB A: The Addiction Patterns of Aerosol Dusters

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United States
Consumer Product Safety Commission
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Memorandum

TO: Cheryl Scorpio, Ph.D.
Project Manager, Aerosol Duster Petition
Directorate of Health Sciences

DATE: July 26, 2023

THROUGH: Stefanie Marques, Ph.D.
Division Director of Pharmacology and Physiology Assessment
Directorate of Health Sciences

FROM: Adrienne Layton, Ph.D.
Pharmacologist, Division for Pharmacology and Physiology Assessment
Directorate of Health Sciences

SUBJECT: The Addiction Patterns of Aerosol Dusters

Introduction

Aerosol dusters products, often referred to as "canned air," contain nominally 100% DFE that is used as a propellant and can be inhaled[39]. DFE causes hypoxia[40] and lightheadedness (Bowen, 2011), and works through specific brain receptors to elicit psychological effects (Duncan, 2013). DFE from aerosol dusters is the "drug of choice" for someone choosing to abuse inhalants to get "high" because it contains nominally 100% DFE which is lipophilic, can be sprayed directly into the lungs, and goes directly to the brain to exert its effects. They are inexpensive and can be purchased in single cans or in bulk, at retail stores on online for home delivery. Because the concentration of DFE in products[41] other than aerosol dusters are much lower than aerosol

[39] Aerosol propellant is a liquid which exists in equilibrium with a gas (liquified propellant such as DFE), or compressed gas that are used to expel aerosol content from a pressurized container. In the case of aerosol dusters, propellant is a single component of the aerosol.
[40] Hypoxia is a decrease in oxygen supply to a tissue.

[41] Such as spray paints, markers, glues, and cleaning fluids.

dusters, and other inhalant products may contain liquids such as paint or oil in addition to the gaseous propellants,[42] modifications to the process of inhaling other products must be performed such as bagging (Koehler, 2014).

Inhalants in general are legal, widely available, inexpensive,[43] and easily concealed for intentional misuse by abusers (Williams, 2007). Other aerosol products[44] can be inhaled as well that contain various intoxicating chemicals. Abusers may include those who are mentally ill, juvenile[45] and those involved with the criminal-justice system (Howard 1999, Beauvais 2001). Most journal articles focus on "inhalants" in general, makes it more challenging to find information specifically on aerosol dusters as opposed to other inhalant use.

<u>Inhalant Abuse</u>

Inhalant abusers differ in background and the specific drugs used to inhale. Inhalant abuser populations can be categorized as young inhalant abusers, poly drug abusers, and inhalant-dependent adults (Beauvais 2001, Ridenour 2007). Inhalant abusers inhale primarily for any of these three reasons: (1) for occasional use for entertainment; (2) in place of another substance until that substance could be obtained or to alter the subjective effect of that substance; and (3) for use in day long binges (not for the next day or for several days) (Ridenour 2007). Inhalant abuse may negatively impact brain development in adolescents, especially white matter connectivity, which continues to develop throughout adolescence (Lubman et al., 2007; Yücel et al., 2008). The National Survey on Drug Use and Health (2020) indicates, without considering alcohol and tobacco, inhalants are the second most abused drug among high school students after cannabis (Cruz 2021). Some of the characteristics of adolescent inhalant abusers including low parental attachment, drug abuse by parents, low school attachment are like those who abuse alcohol and marijuana. Inhalant abuse most commonly occurs in users' homes although it can occur at school and at parties (McGarvey, 1999).

Adolescents who abuse inhalants are most likely polydrug abusers. This group differs from other multidrug abuser groups in that their abuse of inhalants can range from moderate to severe (Beauvais, 2001). Inhalant-dependent adults typically use inhalants almost exclusively as their drug of choice; they often use daily for several hours a day. Many from this group experience acute and chronic physiological and psychological problems directly due to their inhalant abuse (Beauvais 2001). Compared to abusers of other drugs, inhalant abusers appear to have a unique psychiatric symptomology and likely have an underlying psychological disorder related to alcohol addiction, nicotine, cocaine, amphetamines or hallucinogens, major depression, or attempted suicide (Sakai, 2004; Perron, 2009). As the severity of inhalant-related problems increases, so too does the severity of co-occurring psychiatric and substance-related conditions. A risk behavior syndrome can be manifested as fearlessness and is associated strongly with inhalant abuse which might explain the association between inhalant abuse and

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[42] Information is from the Safety Data Sheet website. Safety Data Sheets | Free SDS Database | Chemical Safety

[43] Aerosol dusters are presumed to be less expensive than other abused drugs.

[44] Air freshener, propane, deodorant, lighter fluid, butane, helium, markers, furniture polish, cologne, hair spray, air conditioner refrigerant, piano cleaner, nail polish, shoe repellant, dry erase board cleaner, oven cleaner, ethyl chloride, spray starch, automotive sealant, ammonium nitrate moth balls and glass cleaner have been all been used for inhaling.

multiple substance abuse disorders (Perron 2009, Wu 2008). Inhalant dependent youth scored greater in suicidality[46] than those experiencing other psychiatric issues such as depression, anxiety, and traumatic experiences (Perron, 2009).

The motivation for abusers to quit using inhalants rarely occurs because of the low cost and easy availability of the product. The primary reason inhalant abusers quit using inhalants is related to getting tired of using inhalants, disliking them, or health concerns[47] (Garland and Howard, 2011, Tardelli, 2021).

Half-life of the Onset and Dissipation of Intoxication by DFE

The term half-life describes the time it takes for the concentration of a drug in the body to reduce by 50%. This time depends primarily on how long the liver and kidney processes the drug to remove it from the body. Because there is a scarcity of data on the dose and half-life of DFE in humans in an abuse situation, animal data, one DFE drug development safety study, as well as anecdotal abuse data reported from recovery centers are presented below.

A rat pharmacokinetic study was designed to mimic exposure to DFE during abuse with 30 seconds exposure time. The rate of exposure was 20 liters/min. The rats first became significantly intoxicated 20 seconds after exposure to DFE and remained sedated up to 4 min. Blood levels initially rapidly rose to 350 mg/L and declined to about 20 mg/L at 4 min. The half-life of DFE was calculated to be 30 seconds in the rat (Avella, 2010). Using allometric scaling from rat to human, one would expect DFE to have a shorter half-life in a rodent than a human (Phillips, 2017).

To study the use of DFE as a propellant in asthma inhalers, DFE was administered to human volunteers to determine the pharmacokinetic parameters of DFE during and after short-term inhalation exposure. DFE at concentrations of 200 or 1000 ppm was inhaled in healthy volunteers during light exercise in an exposure chamber. Symptoms of irritation and central nervous system effects were analyzed, and inflammatory markers were determined in the blood. DFE increased rapidly and reached average blood levels of 7.4 and 34.3 respectively and was cleared rapidly as well. The average peak blood concentration reached were only 2.3 ug/ml after 2 hours of sustained exposure condition at 1,000 ppm. DFE elimination[48] was observed to have two phases: an initial rapid phase followed by a slower phase. In the initial rapid phase concentrations dropped to <0.7 ug/mL after approximately 12 minutes after exposure to DFE. During the slower phase, the concentration dropped to below approximately 0.007 ug/mL at 22 hours after exposure. The time course of the blood concentrations agreed well with those obtained by simulations a physiologically based pharmacokinetic model[49] (PBPK) (Ernstgard, 2012).

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[46] The **MAYSI-2** is a brief behavioral health screening tool designed especially for juvenile justice programs and facilities designed for 12 through 17 years old who may have important, pressing behavioral health needs.

[47] Inhalants are associated with cardiac problems, dizziness, seizures, and decreased level of consciousness.

[48] Elimination is a specific pharmacokinetic term which describes the removal of a substance from the body.

[49] This type of model describes the relationship between plasma and tissue concentrations, body compartments and time.

The maximum detection time (MDT), necessary to calculate the measurement of the blood level of DFE after huffing has recently been determined in humans. In 2020, Huet used a PBPK model and the abuse patterns of two individuals to determine pharmacokinetic parameters of DFE in rats. The MDT ranged from 7.8 to 15.8 hours which should be sufficient to allow for testing of DFE levels several hours after suspected intoxication. Additionally, forensic determinations of DFE levels have been determined after car crashes involving DFE (Tiscione, 2021).

DFE, also known as HFA-152a, is currently being developed as an alternative propellant in pressurized metered dose inhalers (pMDI)[50], used for the oral administration of drugs. A human clinical study was performed in healthy male volunteers. They were administered four consecutive doses of 50 ul/actuation from pMDI within a six-minute timespan which represented the maximum anticipated single dosing session utilized in pMDI treatment.[51] Oral administration at this dose was well tolerated, had minimal impact on taste scoring and was rapidly cleared from the blood. There were no adverse events during the study (Kuehl, 2022).

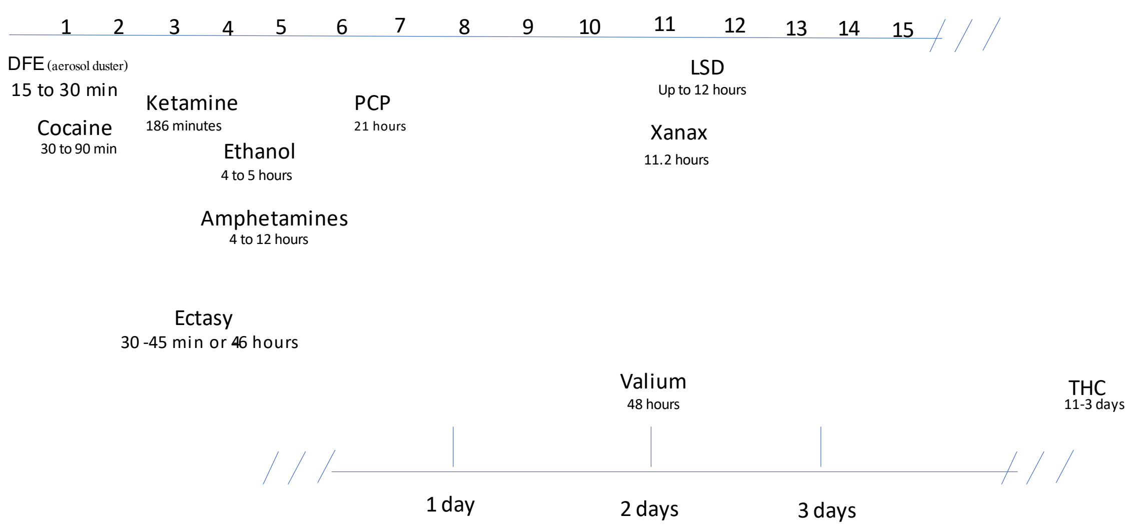

Figure 1. Comparison of Half-Lives of Abused Drugs

While there is no published study regarding the half-life for DFE after huffing, seven recovery center websites on the internet indicate that DFE from aerosol dusters does not stay in an abuser's system very long[52]. This is consistent with the medical literature which states that

[50] To use an inhaler-Place the mouthpiece in your mouth. Close your lips around the inhaler so that you form a tight seal. Tilt your head back slightly. Begin to breathe in through your mouth, press down once on the top of the inhaler.
[51] The medical-grade of HFA-152a for this study ranged from approximately 50 to 150 mg/dose depending upon the drug being studied (Corr, 2020).
[52] https://www.therecoveryvillage.com

inhalant abusers use volatile products that can produce a quick and generally pleasurable sensory experience or "high" with rapid dissipation and minimal "hangover" symptoms (Williams, 2007). Because of the short-lasting effect of DFE the abusers frequently using the chemical to prolong the high by repeated inhalations, which when done in excess can lead to loss of consciousness and even death (Williams, 2007).

Properties of Aerosol Duster Huffing Compared to Other Drugs of Abuse

Inhaling DFE-containing products produces psychological effects through the specific brain receptors for glutamate/NMDA, GABA, dopamine, and opioids and the intoxication caused by inhaling DFE is not caused by just lack of oxygen to the brain. Chemical and pharmacokinetic properties of the drugs, such as absorption, distribution, metabolism, half-life, and excretion influence the effects that any drug has. Aerosol dusters have the shortest half-life of 15 to 30 minutes and marijuana (THC) has the longest half-life of 3 to 11 days (Figure 1). After inhalation, patients reported intoxication to be a "kick/high/euphoria/ feeling of relaxation" with one or more of the following symptoms: giddiness, unsteadiness or perceptual disturbances, unconsciousness or delirium and lightheadedness (Bowen, 2011). The onset of the psychoactive effect of DFE is rapid[53]; conversely after inhalation, dissipation of euphoric effects is also rapid (Wang, 2018). CPSC staff has not been able to identify the specific pharmacokinetic properties of the receptor binding of mediators responsible for the euphoria after inhalation. However, in general, intoxication after inhaling a volatile substance is reported to occur within seconds with the intoxicating effects lasting anywhere from 15 to 60 minutes.

Table 1. Properties of 1,1 Difluoroethane Compared to Other Drugs of Abuse

Drug Category	Drug Names	Nervous System Effect[54]
Ethanol	Ethanol	Miosis[55], ataxia[56], agitation, sedation, coma
Hallucinogens	LSD, PCP, ecstasy, ketamine, cannabis	Euphoria, auditory and visual hallucinations, nystagmus[57], ataxia, psychosis, mydriasis[58], coma
Inhalants	In various products	Euphoria[59], sedation
Marijuana	Cannabis	Agitation, sedation, psychosis
Opioids/Opiates	Heroin, fentanyl, oxycodone, morphine	Euphoria, sedation, coma
Sedative Hypnotics	Benzodiazepines (Xanax, Valium) and	Sedation, coma, ataxia, nystagmus

[53] 15 to 60 minutes
[54] Medical terms are defined in Appendix X.

[55] Miosis is the contraction of the pupil of an eye

[56] Ataxia is a group of disorders that affect coordination, balance and speech

[57] Nystagmus is fast uncontrollable eye movement

[58] Mydriasis is prolonged dilation of the pupil of an eye

[59] One person who abused inhalants referred to aerosol duster use as … It's Like Nitrous Times Infinity - Air Duster Experience Report #1 - YouTube

	Z-drugs (Ambien and Lunesta)	
Stimulants	Amphetamines, cocaine, Nicotine, caffeine	Agitation, psychosis, mydriasis

Side Effects of Abuse and Withdrawal of 1,1 Difluoroethane

Addictive disorders become permanent with high levels of craving and impulsivity (Alonso Matias 2019). Early behavioral alterations are exacerbated based upon the duration of time and quantity of the drug that is inhaled. Research has identified a possible withdrawal syndrome for DFE with symptoms that include irritability, headache, dry mouth, nausea, anorexia, sweating, tics, sleep disturbance and mood changes (Nguyen, 2016, Perron, Howard, Vaughn and Jarman, 2009). Inhalants abuse result in changes to neural psychological pathways of reward and reinforcement (Duncan, 2013).

Auto Accidents Involving 1,1 Difluoroethane Abuse

Six automobile accidents following aerosol duster inhalation were identified by staff in the medical literature where three people died and three people recovered from the accident. Blood was collected from the victims in three incidents to test for DFE concentration (Tiscione, 2021). In one incident DFE was the only compound detected in the blood sample. In another incident, DFE and citalopram (an antidepressant), were detected. In the third case, DFE was detected but was below the level which could be accurately calculated by the method.

In addition to automobile accidents identified in the medical literature by staff, staff also identified NEISS cases of automobile accidents following aerosol duster inhalation. NEISS incident narratives describe car crashes into a brick wall, a stone wall, a building, an embankment, and in multiple incidents, into a tree. Some of the narratives describe the speed of the crash (e.g., 45 miles per hour, or high-speed) or the crash as a rollover. The incidents describe drivers blacking out or passing out while “huffing an aerosol duster” and driving.

A consultation[60] with an inhalant expert found anecdotal evidence that huffing 20g of DFE caused very erratic driving resulting in a car accident (Tiscione, 2021). The driver had purchased 2 cans of aerosol duster approximately 20 minutes before the crash. One can was opened and weighed 20g less than the unopened can. It was suspected that the driver inhaled air duster prior to the accident. Blood was collected to determine the DFE level for the individual. DFE was detected but was not accurately able to be quantified because it was below the limit of detection of the method and was therefore not able to be confirmed (Tiscione, 2021). Automobile accidents as a result of huffing aerosol dusters while driving identified in the published medical literature are shown in Appendix I.

In Depth Investigation (IDI) of NEISS Incidents of 1,1 Difluoroethane Inhalation Deaths

CPSC performed twenty-five in depth investigations from September 2022 through February 2023. All the incidents selected for an IDI involved aerosol dusters that contained DFE. Decedents were between the ages of 22 and 60 years old and most had previously used drugs

[60] HS staff consulted with Dr. Brian Perron from the University of Michigan from the School of Social Work.

and alcohol. Most of the deaths in the IDIs were indicated as being in the victim's homes, in the bedroom or bathroom. One victim started using aerosol dusters one month prior to her death. To commit suicide, one individual used over 20 cans. In another case a shopping bag had been found outside the front door of the deceased with multiple packs containing 2 cans of aerosol dusters. Details of the IDI cases can be viewed in Appendix I.

<u>Discussion</u>

DFE is the drug of choice for many individuals because of its low cost, ease of availability, and it provides immediate euphoria without lingering effects like other drugs. Aerosol dusters contain nominally 100% DFE that is administered directly into the lungs resulting in a quick high. The drug effects of DFE clear quickly from the body. Other inhalants contain various other substances like paint or oil besides the propellant which may interfere with ease of use for inhalant abuse. Opiates and hallucinogens may produce a similar euphoria in a short time, but their effects are long lasting (Wang, 2018). Additional research is necessary about the similarities and differences of specific abused inhalants (Howard 2011). However, it is notable that opiates have an antagonist[61] to reverse opiate's toxic effects, while the toxic effects of DFE can't be reversed.

CPSC staff were unable to find a definitive dose of DFE that produces intoxication from the published literature, FDA has published a guidance to estimate a maximum safe dose in initial trials of a therapeutic drug in healthy human volunteers. This FDA guidance may be used to determine a safe dose of DFE.

In addition, one aerosol duster canister can be sprayed approximately 125 times before it is empty. Huffing twenty grams of DFE from an aerosol duster can has been reported to contribute to a car accident (Tiscione, 2021). Anecdotal evidence suggests that even one spray from a can[62] is intoxicating enough to cause an individual who drives a car to get into a car accident.

<u>Conclusion</u>

DFE abusers experience euphoria because aerosol dusters contain nominally 100% DFE which can be sprayed directly into the lungs and travel directly to the brain and exert its psychological effects. The "high" aerosol duster abusers experience is rapid with minimal "hangover" symptoms. The onset of the psychoactive effect of DFE occurs through specific brain receptors. Huffing aerosol dusters containing DFE is addictive and associated with symptoms of craving and withdrawal. Automobile accidents have occurred after huffing DFE which result in injuries and death.

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[61]. An antagonist rapidly reverses another drug's effect. Naloxone rapidly reverses opioid overdose
[62] Personal Communication with Dr. Brian Perron, an inhalant abuse expert from the University of Michigan. that one spray blast from a can of aerosol duster containing DFE is enough to get someone intoxicated enough

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Appendix I. Incident Investigations of Aerosol Duster Deaths in the NEISS Database [63]

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
220908 HCC1348 (MS)	A 37-year-old man was huffing a computer AD and started experiencing shortness of breath and chest pains. The victim called 911 and was trans-ported to the hospital where he died from cardiac arrest.	Antidepressant	Hotel room	Over 100 AD cans	Yes	Suicide attempt Told EMS he inhaled over 20 cans
220908 HCC1349 (MS)	A 45-year-old woman was huffing an AD gas cleaner and was found face down on her bed. The official cause of death was accidental asphyxiation from DFE inhalation.	N/A	N/A	Home in bed	More than 10 cans	The AD was purchased at a big box general merchandise retail store.
221012 HCC1109 (OH)	A 28-year-old male was found deceased, in a running shower, at his apartment. Police officers found numerous bottles of compressed air on the floor in the living room area of the residence. No autopsy was performed.	N/A	N/A	Home in a running shower	Numerous bottles on the floor	Suicidal based upon a conversation with this mother

[63] [63]Alc=alcohol, DA= other drugs of abuse, AD=aerosol duster, M=marijuana, N/A=not available

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
221012 HCC1110 (TN)	A 35-year-old male was found dead in a wooded area with a plastic trash bag over his head and arms. Several cans of AD were found near the body. The cause of death was accidental DFE toxicity.	N/A	N/A	N/A	N/A	N/A
221012 HCC1111 (TN)	A 22-year-old man returned home from work. The man's mother checked on him and found him on the floor and cold to the touch. The victim's father called 911. Police and EMS responded to the incident. The victim was pronounced dead at the scene. The cause of death was determined to be acute DFE.	Alc, DA, antidepressants	Bedroom of his room	N/A	N/A	N/A
221013 HCC1131 (MI)	A 38-year-old female was found lying face down in her home with a can of air duster spray next to her. The victim's husband stated she started using "air dusters" approximately one month prior to the incident. The husband discovered the victim face down and seizing from huffing approximately two weeks prior to the incident. Per the medical examiner, the cause of death was acute DFE toxicity, and the manner was accidental.	Alc, DA, antidepressant, Another inhalant (Nitrous oxide)	N/A	1 can	N/A	Started using dusters one month prior to death.

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
221013 HCC1132 (MI)	A 40-year-old man was discovered slumped over and not breathing in his vehicle. The man was pronounced dead at the hospital. The official cause of death is intoxication by DFE.	N/A	N/A	N/A	N/A	N/A
221109 HCC1319 (ME)	A 57-year-old male died from difluoroethane toxicity after huffing the contents of an aerosol can.	DA, antidepressants	Home	N/A	N/A	N/A
221109 HCC1320 (FL)	The victim suffered from mental illness and smoked marijuana. Law enforcement was notified by a resident that there appeared to be a dead manatee in the canal behind her home. They found a deceased male floating in the canal.	N/A	N/A	N/A	N/A	AD purchased from local drug store.

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
221109 HCC1321 (FL)	The 39 YOM was found expired in his bed by a friend and law enforcement found "hundreds" of cans of compressed cleaning air in the home. The medical examiner's report indicated the cause of death as DFE toxicity, and the manner of death was accidental.	DA	N/A	N/A	Hundreds of cans	N/A
221109 HCC1322 (ME)	A 60-year-old male died because of huffing a duster inhalant from an aerosol can. The decedent was dead on arrival after being found during a wellness check by a relative.	N/A	N/A	N/A	N/A	N/A
221201 HCC1461 (SC)	After not hearing from a 34-year-old man for a few days, a friend checked on him at his home. A container of aerosol duster was in the bathtub with the victim. A subsequent investigation by the local coroner’s office determined the victim’s death was due to acute DFE toxicity.	N/A	Bathtub at residence.	N/A	N/A	N/A

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
230103 HCC3355 (OR)	A 48-year-old female victim died due to toxic effects of inhalants causing asphyxia after she was found in her motel room with two cans of compressed AD cans. She was declared dead at the scene.	N/A	Motel room	N/A	N/A	Purchased at a drug store
230103 HCC3356 (OR)	A 31-year-old female victim due to DFE toxicity after she was found dead in her apartment with several cans of compressed air electronics cleaner littered around. She was declared dead at the scene.	Alc	Her apartment in bed	N/A	40 to 50 cans.	A shopping bag had been delivered outside the front door with multiple 2 packs of compressed air.
230320 HCC1971 (MA)	A 64-year-old female was found deceased in her home after huffing duster inhalants. The cause of death was DFE intoxication.	M	Her apartment	Multiple cans	Yes	N/A

Task Number State ()	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
230320 HCC1975 (MA)	A 31-year-old male was found dead in a wooded area. He died in the hospital two days later. The cause of death was DFE dysrhythmia and alcohol intoxication.	Alc, glue	In the forest	5 cans	Yes	The AD was purchased at a drug store. Anxiety, depression, past stroke
230320 HCC1976 (TN)	A 38-year-old male was found deceased in his apartment. An AD was found in his hand. Drug paraphernalia and alcoholic beverages were near his body. The cause of death was accidental DFE oxycodone, and alcohol toxicity.	Alc., DA, oxycodone	His apartment	N/A	N/A	Had depression and previous suicidal thoughts
230328 HCC1021 (AR)	A 35-year-old woman was deceased after inability to revive her by EMS personnel The woman had been found lying, unresponsive, in a bathtub at her home by family members. Cause of death to be DFE intoxication. The victim did not have a known history of huffing and first responders did not see any canned air at the residence.	M,	Bathtub at home	N/A	N/A	No known history of huffing, no cans of AD at residence

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
230328 HCC1023 (AR)	A 45-year-old woman was found on her bedroom floor with a partially used aerosol can of AD spray on the floor beside her. Two other AD cans were found on the bed. One can was empty. and other one was full. Cause of death to be DFE toxicity.	Alc, and DA	N/A	An empty AD can was on the bed, a partially used AD can and a used AD can of on the floor next to her.	N/A	N/A
230328 HCC1027 (AR)	A man was found dead in his bedroom with an AD can in his hand. Several other cans of AD were found in the garbage can, on the floor, and in the bathroom. The state medical examiner deter-mined the cause of death to be difluoroethane intoxication.	Depression, History of duster abuse.	Bedroom	Multiple cans. One can in his hand	N/A	Depressed and committed suicide The AD purchased from a big box store
230328 HCC1029 (AR)	On June 15, 2021, a 35 YOM was found deceased in his bathroom by his sister. Near the body were compressed air cans. The cause of death is inhaled, "huffing" toxic substance, difluoroethane from aerosol can.	N/A	N/A	N/A	N/A	N/A

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
230329 HCC1048 (GA)	Local law enforcement was dispatched on a welfare check at the 28-year-old male victim's residence. The maintenance man unlocked the door, and the victim was found unresponsive, face down on the bedroom floor. Law enforcement observed a plastic grocery bag and two aerosol duster cans near the victim. The victim was declared deceased on the scene. The cause of DFE.	DA	N/A	Bedroom floor	2 aerosol cans found near the victim	N/A

Task Number State ( )	Narrative	Other Drug Use	Location of Death	Number of cans fond at death site	Were DFE levels measured?	Other
221109 HCC1321 (FL)	The 39 YOM was found expired in his bed by a friend and law enforcement found "hundreds" of cans of compressed cleaning air in the home. The medical examiner's report indicated the cause of death as DFE toxicity, and the manner of death was accidental.	DA	N/A	N/A	Hundreds of cans	N/A
B 230328 HCC1020 (MA)	A 34-year-old male was found deceased in his bed after huffing a can of aerosol duster. Resuscitation efforts were not attempted as there were obvious signs of death including rigor and livor Mortis.	DA, Alc, Another psychoactive drug	Home in bed	3 cans in his bed and one in his hand. 45 other duster cans found in the house	No	The AD was purchased from a big box store.
A 230328 HCC1033 (AL)	A 38-year-old male was found unresponsive in a motel bathroom floor by his roommate with a can of AD on the floor. Emergency responders were called and unable to revive him. Cause of death was huffing with DFE.	Alc, other psychoactive drug	N/A	Died in bathroom	One can of computer aerosol duster	N/A

TAB B: Aerosol Duster Petition: Alternative Propellants

United States
Consumer Product Safety Commission
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Memorandum

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DATE: July 26, 2023

THROUGH: Stefanie Marques, Ph.D., Director, Division of Pharmacology and Physiology Assessment, Directorate of Health Sciences

FROM: Andrei Komarov, M.D., Ph.D., DABT, Physiologist, Division of Pharmacology and Physiology Assessment, Directorate of Health Sciences

SUBJECT: Aerosol Duster Petition: Alternative Propellants

I. Introduction

The propellant DFE, or HFC-152a, is the most common propellant used in retail aerosol dusters (Chemtronics, 2022). Abusers of aerosol dusters spray the contents of the can into their mouths or inhale it from a cloth or a bag. Injuries resulting from aerosol duster abuse include frostbite, rapid airway compromise, cardiovascular and multi-organ toxicity, and cardiac arrhythmia (Perron et al., 2021; PubMed, 2018). Furthermore, abrupt cessation of DFE abuse can induce withdrawal[64] (PubMed Central, 2020).

Staff considered the use of alternative propellants to DFE for aerosol dusters. This memorandum reviews the toxicity and abuse potential of alternative propellants for aerosol dusters. The United States Environmental Protection Agency (EPA) published previously a list of substitutes propellants based on environmental considerations (EPA, 2022). Technical data for those propellants are listed in the Appendix to this tab.

The chemicals discussed in this memorandum have been selected based on information provided by aerosol companies (Chemtronics, 2022; Techspray, 2023), PubChem, and scientific literature identified by searching PubMed and Google Scholar. Additional information on propellants-based consumer products was retrieved from the Consumer Product Information Database (CPID).[65] The final list of

[64] Withdrawal can include tremors, excessive sweating, nausea, vomiting, depression, anxiety, irritability, psychosis, and hallucinations.
[65] CPID (whatsinproducts.com)

alternative propellants considered in this memorandum includes HFC-134a, volatile hydrocarbons, dimethyl ether, nitrous oxide, carbon dioxide, nitrogen, ethane, and hydrofluoroolefins[66].

II. Discussion

A. Alternative Propellants

1.HFC-134a

DFE is the most common propellant used in retail aerosol dusters (Chemtronics, 2022). Similar abuse can occur for aerosol dusters using the propellant 1,1,1,2-tetrafluoroethane, or HFC-134a, which is popular for professional or industrial applications (Romero et al., 2022; Burke et al., 2020; Chemtronics, 2022; SDS, 2020). HFC-134a abuse can cause asphyxia, transient confusion, dangerous cardiac arrhythmias, acute cardiac, liver and kidney injury (Romero et al., 2022; Burke et al, 2020), see Table 1 for details. Consumer Product Safety Risk Management System (CPSRMS) has 14 reported cases of death from intentional HFC-134a inhalation (some in combination with DFE exposure) for 2006-2022 (Tab C), though staff notes that HFC-134a is also used in automobile refrigerant refill kits. Staff also noted that other products similar to aerosol duster products with HFC-134a sold as freeze sprays (Techspray, 2023a).

Limited clinical studies for this chemical in human volunteers (up to 8000 ppm[67] for 1 h) did not produce adverse clinical signs except in one study using inhalation exposure to 4000 ppm for 30 min (PubMed, 2018). This study was terminated after the first patient fainted, having a low blood pressure and pulse, and the second patient developed a rapid pulse and elevated blood pressure (PubMed, 2018). Inhalation of HFC-134a refrigerant can also lead to reactive airway dysfunction syndrome[68] (PubMed, 2016a).

Table 1: Incidents with HFC-134a

Chemical name/product	Summary	Reference
HFC-134a in aerosol duster	A 33-year-old man presented with a near fainting after inhalation of multiple duster cans. Initial laboratory tests were consistent with acute cardiac, kidney and liver injury.	Romero et al., 2022
HFC-134a in aerosol duster plus methamphetamine	A patient presented with torsade de pointes[69] after inhaling tetrafluoroethane, a volatile gas propellant used to clean keyboards. She had a prior hospitalization for cardiac arrest without cardiac rhythm documentation after inhaling a similar product. Urine toxicology revealed methamphetamine.	Burke et al., 2020
HFC-134a in automotive refrigerant	A 60-year-old nonsmoking man without a history of lung disease was exposed to an air conditioner refrigerant spill while performing repairs beneath a school bus. Afterward, he experienced worsening shortness of breath with minimal exertion, a productive cough, and wheezing. He was also hypoxic. He was admitted to the hospital for further evaluation. Spirometry[70] showed airflow obstruction. His respiratory status improved with bronchodilators and oral steroids. A repeat spirometry 2 weeks later showed improvement. Six months after the incident, his symptoms had improved, but he was still having shortness of breath on exertion and occasional cough.	PubMed, 2016a

[66] HFO molecules contain hydrogen, fluorine, and a carbon backbone with one double bond (HFC-152a and HFC-134a contain only a single carbon bond).

[67] Parts per million

[68] Reactive airways dysfunction syndrome is defined as the sudden onset of asthma following exposure to a corrosive gas, vapor, or fume.

[69] Ventricular tachycardia that can lead to life-threatening ventricular fibrillation.

[70] Measures the amount of air a patient is breathing in or out.

2.Volatile hydrocarbons and Dimethyl ether

Volatile hydrocarbons (propane, butane, isobutane, and their mixtures) and dimethyl ether (DME) are used as propellants in a variety of consumer products (PubMed Central, 2011). Volatile hydrocarbons and DME are known to be abused as inhalants (PubMed Central, 2011). Deaths have been reported in the literature for all of these chemicals and their mixtures (Table 2). Volatile hydrocarbon abuse can lead to sudden death in some cases (PubMed, 2006).

Table 2: Incidences of volatile hydrocarbons and dimethyl ether

Chemical name	Summary	Reference
Propane	The study analyzed 39 deaths from volatile substances. The chief volatile substances used were gas fuels (46%), predominately butane and propane, chlorofluorocarbons (26%), chlorinated hydrocarbons and alkylbenzenes (21%), and other volatile substances including volatile anesthetics.	PubMed, 1999
Isobutane	Two fatal cases of sniffing cigarette lighter refill with isobutane have been reported. Toxicological investigations revealed the presence of isobutane in the heart blood and brain tissue of both cases (case 1: heart blood 0.1 microg/g, brain tissue 2.3 microg/g; case 2: heart blood 4.6 microg/g, brain tissue 17.4 microg/g) and the presence of its metabolite 2-methyl-2-propanol in the heart blood of both cases (0.5 and 1.8 microg/g, respectively). The histological investigations of the inner organs showed similar results in both victims.	PubMed, 2006
Butane	Among 54 butane's harmful use/misuse cases identified in the literature, there were 11 survivors successfully discharged from the hospital and 43 deaths. Patients were predominantly males with a mean age ± SD of 23 ± 13 years. The main route of exposure was inhalation. Manifestations were mainly cardiac and neurological. To conclude, butane exposure is at risk of severe central nervous system and cardiac toxicities, which may result in a fatal outcome.	PubMed, 2022a
DME[71]	The presence of the volatile substance DME was identified in brain tissue of a 38-year-old man with history of anxiety, depression and post-traumatic stress disorder after DME overdose. The body was in a moderate state of decomposition surrounded with aerosol cans (muscle 'freeze' spray). DME was found in combination with ethanol in the brain and other prescribed drugs in skeletal muscle.	PubMed, 2015

CPSRMS (from 2006-2022) has 5 reported cases of death from intentional propane inhalation (some in combination with ethane exposure, other in combination with butane and DFE exposure), 8 cases of death from intentional butane inhalation, 3 cases of death from intentional isobutane inhalation, and 2 cases of death from intentional DME inhalation (Tab C).

3. Nitrous oxide

Nitrous oxide (N_2O) has been in use as an anesthetic for nearly 200 years. It is also increasingly popular for inhalant abuse (Sagepub, 2022). Adverse effects of N_2O gas have been described in medical use (PubMed, 1986), including hypoxia immediately after N_2O administration, undesirable reproductive outcomes during the first two trimesters of pregnancy, and negative effects on white blood cell production and function. N_2O gas in small canisters is used for whipped cream dispensers, from which the term "whippits" or "whippets' is derived. Inhaling N_2O from these canisters is likely popular due to its euphoric effects, low cost, and ease of access. While acute toxicity of N_2O is rare, chronic N_2O abuse can cause functional vitamin B-12 deficiency resulting in multiple neurologic deficits. N_2O abuse can increase homocysteine levels leading to venous thromboembolism[72]. Many patients demonstrated improvement in

[71] DME has some limited use in aerosol dusters (Chemtronics, 2022)
[72] A blood clot that prevents the flow of blood in veins.

symptoms when discontinuing use of N_2O, and vitamin B-12 supplementation is considered a reasonable therapeutic intervention (ACEP, 2021).

N_2O abuse is associated with hallucinations, confusion, persistent numbness, and accidental injury. Accidental injury is observed with the highest number of 'hits' per session, suggesting a dose-response relationship (PubMed, 2016). Case reports from the literature related to N_2O abuse are presented in Table 3.

Table 3: Incidences with N_2O.

Chemical name	Summary	Reference
N_2O plus vitamin B-12	Four patients presented with neurological symptoms in the setting of chronic N_2O abuse. Each reported using 50 to 150 N_2O cartridges ("whippets") almost daily and reported supplementing with oral B-12. All patients had clinical signs of neurotoxicity, and a functional B-12 deficiency. Three had imaging consistent with spinal cord degeneration.	PubMed, 2022b
N_2O and methamphetamine	A 34-year-old female with a history of alcohol and crystal methamphetamine abuse presented to the emergency department with neurological symptoms and difficulty walking. At a primary care visit a week earlier her symptoms had been viewed in the context of anemia and she was started on daily B-12 injections. Upon further investigations in hospital, the patient was diagnosed with subacute combined degeneration neuropathy secondary to nitrous oxide abuse that had affected B-12 activation.	BCMJ, 2016
N_2O	The findings confirm N_2O as a very common drug of abuse in the UK and US. N_2O was generally consumed via gas-filled balloons, at festivals and clubs where use of other substances was common. Most users used it infrequently, and their use was not associated with significant harm. However, there appears to be a subpopulation of heavy users who may be using in a dependent pattern. Analysis of N_2O users, confirms that N_2O is associated with hallucinations and confusion (which may be the desired effects) and persistent numbness and accidental injury. Accidental injury is associated with the highest number of 'hits' per session, suggesting a dose-response relationship.	PubMed, 2016

CPSRMS (from 2006-2022) has 10 reported cases of death from intentional N_2O inhalation (Tab C).

4. Carbon dioxide

Carbon dioxide (CO_2) is used in aerosol sprays, BB guns, and as dry ice. CO_2 gas is available in small metal cartridges. Commercial CO_2 mini gas dusters (a dispenser with replaceable cartridges) as stated by the manufacturer deliver about 150-200 short half-second blasts per 16-gram gas cartridge of CO_2 (American Recorder Technologies, 2022a). The disadvantages of CO_2 use as a propellant include the low capacity of CO_2 cartridges and a spray force that is less than that of liquid propellants,[73] which may deliver a similar number of longer blasts as described in Tab D, however CO_2 cartridges can then be readily replaced into the same nozzle. A limitation of this technology is that CO_2 spray force diminishes as the cartridge runs out, so the first half of the cartridge is more effective than second half (Chemtronics, 2022).

The literature reported about 90 deaths per year from CO_2 exposure related to work in confined spaces and the use of dry ice (PubMed Central, 2017) and 0 deaths from CO_2 used as a propellant. CPSRMS (from 2006-2022) has 6 reported cases of death from asphyxiation due to intentional CO_2 inhalation (Tab

[73] The term liquid propellants refer to volatile hydrocarbons, DME, DFE, HFC-134a, and HFO.

C). CO_2 can cause asphyxiation[74] by hypoxia but also acts as a toxicant. At high concentrations, CO_2 can cause unconsciousness almost instantaneously and respiratory arrest within one minute (PubMed Central, 2017). The literature described several suicide cases with CO_2 (Table 4).

Table 4: Incidences with CO_2.

Chemical	Summary	Reference
CO_2 (a dry ice)	There was a suicide case suspected to result in death from carbon dioxide poisoning by dry ice in the car. There were signs that 50 kg of dry ice was brought in the car. To clarify the cause of death, reproducibility testing was carried out by using a car under the same conditions. CO_2 concentration in it increased to 22% and O_2 concentration decreased to 16% within 20 minutes. From these observations, the death was caused by hypoxia and CO_2 narcosis. CO_2 in the suicide victim's blood was higher than those in the blood of healthy persons, and the same range was visible in the blood of fire victims.	PubMed, 2009b
CO_2 (a dry ice)	This paper presents two uncommon suicides by carbon dioxide intoxication. In one case, a 53-year-old man tightly sealed a small bathroom and locked himself in it likely with dry ice. Warning notices were tagged to the door. In another case, a 48-year-old man working in a restaurant committed suicide by closing himself in a walk-in refrigerator and opening the stored carbon dioxide containers intended for the beverage dispensing equipment.	PubMed, 2013a

CO_2 toxicity described in mice and rats at high CO_2 concentrations (PubMed, 2010; PubMed, 2020). Developmental effects were observed in mice using environmentally relevant CO_2 levels (PubMed, 2021).

5. Nitrogen

Nitrogen (N_2) gas is used as a propellant in cosmetic sprays, air fresheners, and household cleaners. The disadvantages of N_2 gas as a propellant are the same as those for CO_2. Spray force diminishes as the cartridge runs out, so the first half of the cartridge is more effective than the second half. Commercial nitrogen gas duster (a dispenser with replaceable cartridges) as stated in a consumer comment about this product provides only 20 bursts per 18-gram gas cartridge of N_2 (American Recording Technologies, 2002b).

Atmospheric air[75] that we breathe contains 78% N_2, however purified N_2 gas acts as a simple asphyxiant[76] (CSB, 2003). CPSRMS (from 2006-2022) has 4 reported cases of death from asphyxiation due to intentional N_2 inhalation (Tab C).

6. Ethane

Ethane (a colorless odorless gas with a chemical formula C2H6) has been also proposed as a propellant. However, ethane is a highly flammable gas forming explosive mixtures with air (CAMEO Chemicals, 2022). In confined spaces, ethane can act as a simple asphyxiant (CAMEO Chemicals, 2022). Ethane is used in blends with other propellants. CPSRMS (from 2006-2022) has 2 reported cases of death from intentional ethane inhalation (in combination with propane, methane, isobutane and butane exposure) (Tab C).

7. Hydrofluoroolefins (HFO)

[74] Suffocation due to the lack of oxygen.
[75] Air is not frequently used as a propellant. It has the same limitations as other gases. Air was only recently introduced in the US, and the verdict is still out.
[76] A nontoxic gas which reduces the normal oxygen concentration in breathing air leading to suffocation.

HFO molecules contain hydrogen, fluorine, and a carbon backbone with one double bond[77] (HFC-152a and HFC-134a contain only a single bond between carbons). This is a new generation of refrigerants with a low potential to increase global warming (PubMed, 2018).

The company named Chemtronics offers Typhoon Blast 70 Duster (Chemtronics, 2022), which contains propellant HFO-1234ze (trans- 1,3,3,3-tetrafluoropropene), and another company Miller-Stephenson offers MS-222L Aero- Duster Ultra with the same ingredient (Miller-Stephenson, 2023). A similar product is offered by Falcon Safety Products, Inc., as Dust-Off Eco-6 (SDS, 2021). The products with a new propellant HFO-1234ze listed above are marginally more expensive than current retail aerosol duster products with DFE. This is likely due to newer technology, which has not yet been widely adopted for larger volume applications like air conditioning (Chemtronics, 2022). HFO-1234ze is also considered for medical use as a propellant in pressurized metered-dose inhalers (OINDPnews, 2022). Another chemical, HFO-1234yf (2,3,3,3-tetrafluoropropene) is widely used as a refrigerant in many new cars produced in the United States and the European Union (MACS, 2017).

The toxicology and metabolism of HFO-1234ze have been studied in mice and rats (PubMed, 2009a; PubMed, 2013b; PubMed, 2018). HFO-1234ze was not acutely toxic following inhalational exposure (4-hour LC50[78] in the rat was greater than 207,000 ppm[79]). However, 2-week, 4-week, and 13-week inhalation studies demonstrated mononuclear cell inflammation of the heart in both sexes, which was observed consistently at 15,000 to 20,000 ppm level regardless of the duration of exposure (PubMed, 2013b). A chronic study was not conducted for HFO-1234ze. There was a lack of mutagenic activity in all mammalian cell studies and no significant metabolic activity. HFO-1234ze is not likely to be carcinogenic. Inhalation exposures up to 15,000 ppm HFO-1234ze to pregnant rabbits did not cause maternal toxicity. Also, there were no effects on pup live birth, sex ratio or malformations (PubMed, 2018). An acute consumer exposure limit of 420 ppm is recommended for HFO-1234ze by EPA (EPA, 2022). HFO-1234ze appears to be safe based on animal studies, however this chemical has not been studied in people.

The abuse potential for these chemicals is unknown due to their relatively low use in consumer applications. Similarly, other human effects have not been reported (PubMed, 2018).

B. Mechanical alternatives

Mechanical alternatives to aerosol dusters include a variety of electric air blowers, which are free of chemical propellants (Street Reviews, 2022). Technical details of these devices are described in the Engineering memorandum (Tab D).

C. Summary

HFC-134a is currently used in aerosol dusters and it is also known to be abused in a similar fashion to DFE. HFC-134a abuse can lead to asphyxia, transient confusion, dangerous cardiac arrhythmias, acute cardiac, liver and kidney injury. Deaths from intentional HFC-134a inhalation have been reported in CPSRMS.

Volatile hydrocarbons, DME, and nitrous oxide are well-known inhalants with high abuse potential. In some cases, volatile hydrocarbon abuse leads to sudden death, as described for DFE. Deaths from intentional inhalations of volatile hydrocarbons and DME have been reported in CPSRMS. Abuse of N_2O is associated with hallucinations, confusion, persistent numbness, and accidental injury. Chronic N_2O abuse also leads to multiple neurologic deficits and venous blood clots. Deaths from intentional N_2O inhalation have been reported in CPSRMS.

The literature described several suicide cases where CO_2 was used. Deaths from intentional CO_2 inhalation have been reported in CPSRMS. Commercial CO_2 gas aerosol dusters available on the market

[77] A covalent bond between two atoms involving 4 bonding electrons as opposed to 2 electrons in a single bond.
[78] LC50: chemical concentration in the air that kills half of the experimental animals.
[79] Parts per million

could be best described as a niche product, however this does present one possible alternative to DFE. The disadvantages of using CO_2 as a propellant include the low capacity of CO_2 cartridges and a spray force that is less than that for liquid propellants. In addition, CO_2 spray force diminishes as the cartridge depletes, so the first half of the cartridge is more effective than the second half. These limitations often require consumers to use multiple replaceable cartridges, which may cost more to perform the same amount of dusting as a DFE duster.

N_2 and ethane can act as simple asphyxiants. The disadvantages of N_2 gas as a propellant are the same as those for CO_2. Ethane has been also proposed as a propellant. However, ethane is a highly flammable gas forming explosive mixtures with air. Ethane is used in blends with other propellants. Deaths from intentional inhalations of N_2 and ethane have been reported in CPSRMS.

HFO is a new generation of refrigerants with a low potential to increase global warming, which are also considered for use as propellants for aerosol sprays. HFO demonstrated low toxicity in animals. HFO is proposed to be used in medical metered-dose inhalers in the future. However, the human effects of HFO and their abuse potential are unknown.

It should be noted that many of the efforts to replace known hazardous chemicals have resulted in so-called "regrettable substitutions" where a chemical with initially unknown hazards was used as a substitute for chemical with a known hazard.

III. Staff Conclusions and Recommendations

Health Sciences staff has concluded that many currently available chemical propellants have limitations for use in consumer aerosol dusters due to either their already known high abuse potential (HFC-134a, volatile hydrocarbons, DME, and nitrous oxide), or the known technical limitations of using them in the aerosol dusters application (carbon dioxide, nitrogen, ethane). The human effects and abuse potential for HFO are unknown.

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Appendix[80]

Propellant	Pressure at 70 degrees F (psi)	Flammability
Nitrous oxide	309	No
Carbon dioxide	874	No
Nitrogen	155	No
Ethane	558	Yes/explosive
Propane	124	Yes
Isobutane	46	Yes
Butane	32	Yes
DME	62	Yes
HFO-1234ze	62	No
HFC-152a	79	Yes
HFC-134a[81]	86	No

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[81] In 2016, the U.S. EPA published the Significant New Alternatives Policy (SNAP) rules that would have severely limited the use of HFC-134a to only uses it considered essential. The Federal SNAP rules were halted due to legal challenges and never became law. Since that time, several states have enacted their own rules in addition to the EPA SNAP rule. California was the first to do so and other states have also followed suit (Claire, 2021).

TAB C: Updated Review of Incidents, Injuries and Fatalities Associated with Aerosol Duster Products

THIS DOCUMENT HAS NOT BEEN REVIEWED OR ACCEPTED BY THE COMMISSION

United States
Consumer Product Safety Commission
cpsc.gov | info@cpsc.gov | 800.638.2772

Memorandum

TO: Cheryl Scorpio, Ph.D.,
Project Manager, Aerosol Duster Petition
Directorate of Health Sciences

DATE: July 26, 2023

THROUGH: Steve Hanaway
Associate Executive Director
Directorate for Epidemiology

FROM: Chao Zhang
Division of Hazard Analysis
Directorate for Epidemiology

SUBJECT: Updated Review of Incidents, Injuries and Fatalities
Associated with Aerosol Dusters

I. INTRODUCTION

Staff from the Hazard Analysis Division of the Directorate for Epidemiology (EPHA) prepared this review of data involving misuse or intentional abuse of aerosol dusters. This review presents information on deaths, injuries and non-injury incidents from misusing or intentionally abusing (commonly known as *huffing* but referred to here as *inhaling* or *inhalation*) of aerosol dusters. This review also presents information on fatal incidents that were attributed to DFE toxicity, but where the specific product(s) involved were either unknown or could not be reasonably identified as an aerosol duster.

The NEISS–based injury estimates and reported incidents from CPSC's CPSRMS are from January 1, 2006 to December 31, 2022. Data collection is ongoing in CPSRMS and reporting is considered incomplete for the latest three years.[82]

This memorandum is an update to the memorandum prepared in Spring 2022 for the staff briefing package for the aerosol dusters petition. The previous analysis covered aerosol duster inhalation incidents in CPSRMS from January 1, 2006 to December 31, 2020, and aerosol duster inhalation injury estimates in NEISS from January 1, 2006 to December 31, 2020.

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[82] The most recent search of the CPSC databases for incidents involving misuse or intentional abuse of aerosol duster products was conducted on April 5, 2023. Product codes searched were 1133 (Aerosol containers), 0921 (Chemicals not elsewhere classified) and 0954 (General-purpose household cleaners). Aerosol duster products are included as a sub-category of product code 0954 but may occasionally be sorted into product codes 1133 and 0921. In addition, several incidents were found under inaccurate product codes through a broader search of the CPSC databases.

II. RESULTS

The CPSC databases do not contain an exclusive product code for aerosol dusters or deaths attributed to DFE toxicity. Rather, the available relevant product codes are used to categorize all aerosol containers, general-purpose household cleaners, other chemical products and any other general products that may be classified within such categories. Aerosol dusters were identified in CPSRMS and NEISS incident narratives or product descriptions as dusters, aerosol dusters, computer/keyboard/electronics dusters or cleaners, canned/compressed air, or by specific brand names. Deaths attributed to DFE toxicity were identified in CPSRMS through the keyword “difluoroethane” and misspelled variants that were coded under the same product categories as aerosol dusters.

Other volatile substances that appear frequently in inhalation or inhaling incidents, but are not within the scope of this review, include paint products, general household cleaning solutions, refrigerants from appliances, air fresheners, and other aerosol can products containing propellants other than DFE (e.g., aerosol spray paint, whipped cream, etc.). This review also excludes aerosol duster incidents that were exclusively associated with common non-inhalation hazards, such as explosions, fires, chemical burns or respiratory injuries that resulted from the product’s intended use.

CPSRMS Incident Data (2006 – 2022)

Incidents were separated into two mutually exclusive categories: duster incidents (those that involved an aerosol duster), and DFE-related deaths (fatalities where the product(s) involved were unclear or unknown, but the cause of death was DFE toxicity). Fatal incidents caused by DFE toxicity from an aerosol duster product, as defined above, were exclusively sorted into the first category.

Many incidents found in CPSRMS reported deaths due to DFE toxicity did not identify the product that was used by the victim. This is most prevalent in death certificate data, where often, the cause of death is only described as 1,1-difluoroethane toxicity due to inhalant abuse or sniffing/huffing/inhaling aerosols. Although DFE is commonly used as a propellant in aerosol dusters, the compound is also used in other aerosol products, such as pesticides and air fresheners. As such, the number of CPSRMS incidents classified as involving aerosol duster inhalation (“duster incidents”) is almost certainly an underrepresentation of the true number of aerosol duster inhalation incidents that have been recorded in CPSRMS; the addition of the DFE toxicity data may provide a possible upper limit to this unknown quantity.

Between 2006 and 2022, CPSC received reports for 1,210 unique incidents involving inhalation hazards from aerosol dusters (1,201 of which were fatal), and separately, 1,115 additional unique fatal incidents involving DFE toxicity. If all the remaining 1,115 DFE-related deaths can be attributed to aerosol dusters, then there would be a theoretical maximum of 2,325 aerosol duster incidents (including 2,316 fatalities) reported in CPSRMS. Table 1 provides an overview of the severity of these incidents.

Table 1: Severity of Aerosol Duster Inhalation and DFE Toxicity Incidents

Incident Severity	Duster Incidents	Additional DFE Deaths (Potential duster incidences)
Death	1,201	1,115
Emergency Department Treatment Received	2	0
Hospital Admission	1	0
Seen by Medical Professional	1	0
Level of care not known	2	0
No Injury Reported	3	0
Total	**1,210**	**1,115**

Source: CPSRMS (2006-2022).

An overwhelming majority (99.3%) of the aerosol duster inhalation incidents in CPSRMS between 2006 and 2022 resulted in deaths. Most of the CPSRMS incident data for aerosol duster inhalation were comprised of death certificates (995 of 1,210) from states and medical examiners and coroner (175 of 1,210), combining for 96.7% of incidents.[83] The remaining incident data were received from consumers, manufacturers/retailers, online news, health care professionals or unspecified sources. The CPSRMS incident data for DFE-related deaths were entirely comprised of death certificates (1,095 of 1,115) and medical examiners and coroner reports (20 of 1,115).

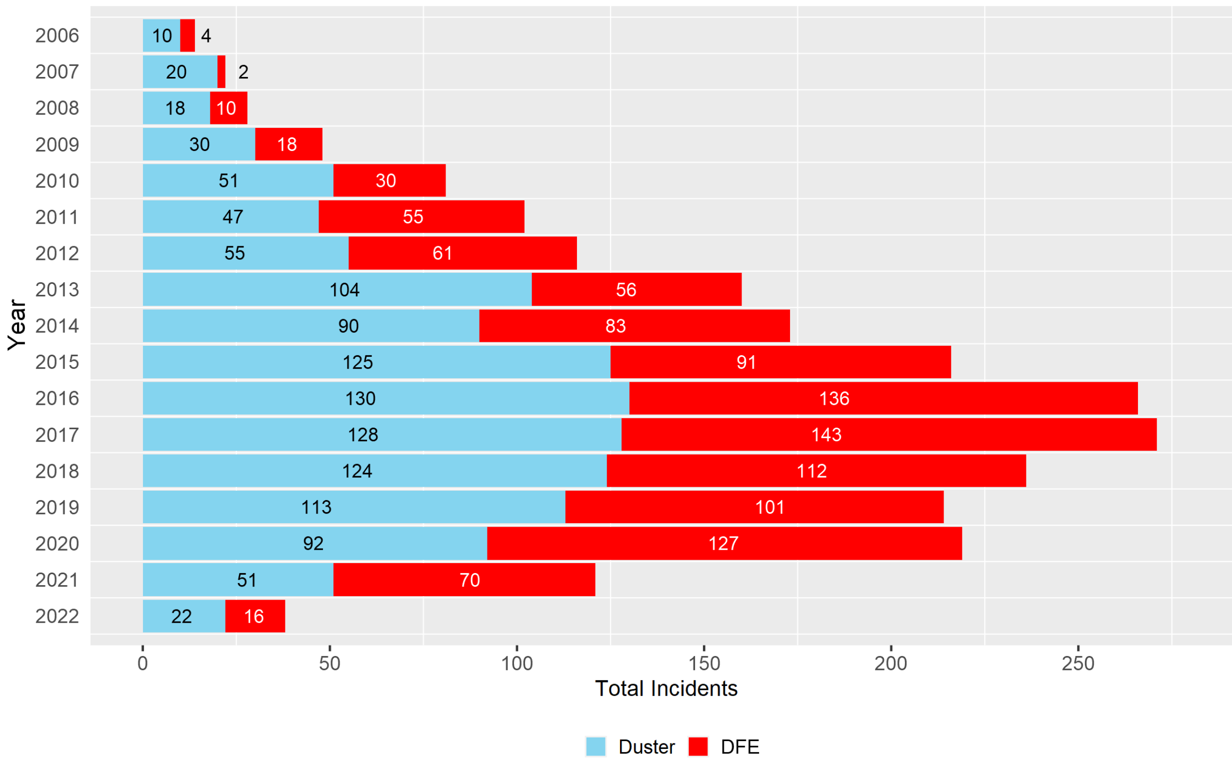
The fatal DFE incident reports that did not explicitly mention an aerosol duster product, but that described the same incident as another report in CPSRMS, were all able to be associated with an aerosol duster inhalation incident; these duplicate reports were not counted a second time among the DFE-related deaths. If assuming all of the remaining 1,115 DFE-related deaths can be attributed to aerosol dusters, then there would be a theoretical maximum of 2,325 aerosol duster incidents (including 2,316 fatalities) that occurred between 2006 and 2022 and were reported in CPSRMS.

Figure 1 provides an overview of the distribution of the number of aerosol duster inhalation and fatal DFE incidents found in CPSRMS per year. It should be noted that data in CPSRMS is anecdotal in nature and does not necessarily represent all incidents that have *actually* occurred. Furthermore, because data collection is ongoing, the numbers may change, especially for the later years.

[83] While most incidents were sourced from a single report, some incidents were linked to 2 or more reports in CPSRMS. As such, there were more than 1,210 reports. Duplicate reports were associated for each unique incident, and the most recent and/or most descriptive report was used as the primary source.

Over 80% of the aerosol duster inhalation incidents in CPSRMS since 2006 occurred between 2013 and 2022. Similarly, around 84% of the deaths attributed to DFE toxicity in CPSRMS since 2006 occurred between 2013 and 2022.

Figure 1: Aerosol Duster Inhalation and Fatal DFE Incidents Reported by Year*



Source: CPSRMS (2006-2022).
*Data collection is ongoing; as such, the counts for the most recent years should be considered incomplete, especially the last 3 years (2020-2022).

Table 2 provides an overview of the distributions of aerosol duster inhalation and DFE toxicity victims by age group and gender. Among the aerosol duster inhalation victims, almost 70 percent of the victims were male, and over 92 percent of victims were between the ages of 18 and 54, with victims ranging between 13 and 70 years old. The fatal DFE-related incidents followed a similar distribution, with around 70% of victims being male, 95% of victims being between the ages of 18 and 54, and victims ranging between 8 and 70 years old.

Table 2: Distribution of Aerosol Duster Inhalation Deaths by Age Group and Gender

Age Group (Years)	Duster Deaths			DFE-Related Deaths		
	Male	Female	Total	Male	Female	Total
0 – 17*	12	14	**26 (2%)**	11	3	**14 (1%)**
18 – 34	347	181	**528 (44%)**	325	147	**472 (42%)**
35 – 54	427	162	**589 (49%)**	408	174	**582 (52%)**
55 or older*	43	14	**57 (5%)**	34	13	**47 (4%)**
Unspecified	1	0	**1(<1%)**	0	0	**0**
Total	**830 (69%)**	**371 (31%)**	**1,201**	**778 (70%)**	**337 (30%)**	**1,115**

Source: CPSRMS (2006-2022).
*The minimum victim age in the data was 8 years, while the maximum was 70 years.
Percentages may not add to 100% due to rounding.

Table 3 provides an overview of the distribution of aerosol duster inhalation incidents and DFE-related deaths in CPSRMS by U.S. state. CPSRMS contains reports for aerosol duster inhalation incidents from 49 states (except for West Virginia) and the District of Columbia, and reports for DFE-related deaths from 47 states (except for Nebraska, South Dakota and Wyoming) and the District of Columbia.

The states with the most duster inhalation incidents received are Florida, Texas, California, Georgia and Illinois. The states from which the most DFE-related death reports were received are Florida, Ohio, Pennsylvania, Illinois and North Carolina. Overall, the states with the most CPSRMS reports included in this analysis are Florida (222), Texas (121), Illinois (115), Ohio (105), Pennsylvania (105) and North Carolina (105). Due to the anecdotal nature of CPSRMS data and lag time between the date of death and when it is reported to CPSC, these counts should not be used to calculate death/incident rates by state.

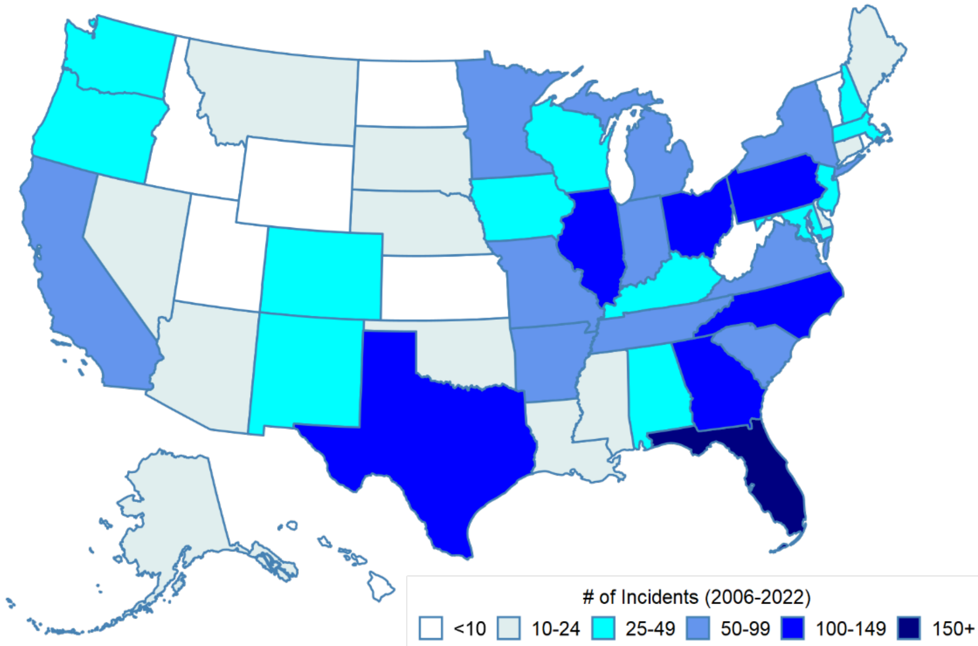
Table 3: Number of Duster Incidents and DFE-Related Deaths Reported by State

State	Duster Incidents	DFE Deaths	State	Duster Incidents	DFE Deaths
Florida	89	133	Massachusetts	15	28
Texas	82	39	Arizona	14	6
California	79	16	Kentucky	14	13
Georgia	62	38	South Dakota	13	0
Illinois	50	65	Maryland	11	35
North Carolina	46	59	Montana	11	2
New Mexico	42	2	Mississippi	10	9
Oregon	42	6	Nevada	10	9
Colorado	40	8	Oklahoma	9	9
Michigan	39	33	Alaska	7	4
Minnesota	38	29	Delaware	7	13
Pennsylvania	37	68	Maine	7	11
Virginia	37	49	North Dakota	6	3
Arkansas	36	35	New Hampshire	6	25
Tennessee	36	28	New Jersey	6	26
Missouri	35	19	Wyoming	6	0
Ohio	35	70	Connecticut	5	17
Indiana	32	38	Kansas	5	2
New York	29	48	Utah	5	1
Wisconsin	27	8	Hawaii	3	2
Iowa	23	19	Rhode Island	3	6
South Carolina	23	35	Vermont	3	3
Washington	22	12	Idaho	2	1
Louisiana	18	4	D.C	1	2
Alabama	16	25	West Virginia	0	2
Nebraska	16	0	**TOTAL**	**1,210**	**1,115**

Source: CPSRMS (2006-2022).

Figure 2 provides an overview of the distribution of *total* CPSRMS incidents (duster inhalation and DFE-related deaths) by U.S. state.

Figure 2: Total CPSRMS Incidents Reported by State



Source: CPSRMS (2006-2022).

Around 68 percent of both aerosol duster inhalation incidents and DFE-related deaths in CPSRMS occurred at a home, apartment or condominium, while around 19 percent of inhalation incidents and 20 percent of DFE-related deaths occurred on public property (e.g., a hotel or store), in an office or other public space (e.g., a street, parking lot, or in the woods). The locale of the remaining 13 percent of inhalation incidents and DFE-related deaths were recorded as unknown or unspecified. Although the majority of incident narratives did not provide detailed information on the victim or the incident circumstances, the following observations were made based on keywords in the more descriptive incident narratives:

- In 133 duster incidents the aerosol duster inhalation victim had a history of previous use of inhalants (including dusters), drugs or alcohol or was simultaneously using drugs or alcohol.
- In 114 DFE-related deaths, the aerosol duster inhalation victim was simultaneously using, or had a history of using inhalants (including aerosol dusters), drugs or alcohol.
- In 34 duster incidents and 8 DFE-related deaths, the victim had a previous history of depression or other underlying mental conditions.
- In 60 duster incidents, all fatal, and 52 DFE-related deaths, the victim was reported to have died from drowning, or was found fully or partially submerged in water, usually a bathtub or a pool.
- In 20 duster incidents and 15 DFE-related deaths, the victim was found in a vehicle, or found operating a vehicle. 19 of the 20 duster incidents resulted in deaths, while one required emergency department treatment of the victim.

Staff also conducted a brief review of fatal intentional aerosol inhalation incidents in CPSRMS involving propellants that could be considered viable alternatives to DFE in aerosol duster products. Between 2006 and 2022, there were 10 deaths from nitrous oxide, 5 from propane, 8 from butane, 3 from isobutane, 2 from dimethyl ether; Staff also found non-aerosol inhalation deaths for other propellants that could potentially be used in aerosol dusters, including 6 from CO_2, 4 from nitrogen gas and 2 from ethane. Additionally, there were 14 deaths found involving tetrafluoroethane, a propellant already used in dusters for industrial applications. Several of these fatal tetrafluoroethane inhalation incidents involved DFE toxicity as well; as such, they were already counted in the above analyses.

Lastly, between 2006 and 2022, there were an additional 117 CPSRMS incidents which mentioned inhalation of unspecified aerosol products, including 116 fatal incidents and 1 involving a permanent brain injury. As the scope of the analyses was determined to only include incidents explicitly mentioning an aerosol duster product or death due to DFE toxicity, these additional incidents are not included among the incidents in the analyses above and are only mentioned to provide information on and context for the excluded incidents.

NEISS-based National Injury Estimates (2006 – 2022)

Between 2006 and 2022, it is estimated that there were 28,800 emergency department (ED) treated injuries in the United States resulting from inhalation of aerosol dusters. This estimate is based on a sample of 638 NEISS injury cases.

Cases were only included in the NEISS sample if the product being used could reasonably be classified as an aerosol duster.[84] While CPSRMS incidents typically report a product's identifying characteristics (i.e., manufacturer, brand, model, retailer, product description), NEISS narratives rarely provide such detailed information on the products involved. As such, the NEISS statistic is likely an underestimate of the number of injuries from inhalation of aerosol dusters. An additional 2,700 ED-treated estimated injuries resulted from inhalation products described as "aerosol cans", "aerosol cleaners", or simply "aerosols", but these injuries are excluded from this analysis because of the non-specificity of the product description and the lack of information on the propellant being inhaled (e.g., DFE). Other types of injuries resulting from both proper and improper aerosol duster use, such as chemical burns or respiratory injuries from the product being sprayed, are not included in the above estimates.

Table 4 presents yearly estimates of ED-treated injuries in the United States from inhaling aerosol dusters. Due to many of the annual estimates in the data's time frame being either too small or too unstable to report, a separate year-by-year trend analysis is not feasible and was thus not conducted.

[84] Keywords used to identify products in CPSRMS and NEISS include: inhalation, inhaling, sniffing, duster, aerosol duster, computer cleaner, keyboard cleaner, computer duster, keyboard duster, electronic duster, compressed air, canned air and specific brand names. Variations and combinations of these keywords were also used to capture misspellings or variations in how the product was identified.

Table 4: NEISS Estimates for Aerosol Duster Inhalation Injuries by Year

Year	Estimate[85]	Sample Size	CV
2006	**	8	.700
2007	**	10	.381
2008	**	17	.346
2009	**	15	.310
2010	**	25	.262
2011	1,800	42	.257
2012	**	25	.274
2013	2,000	46	.224
2014	1,500	35	.281
2015	2,600	47	.255
2016	3,100	67	.276
2017	2,700	67	.218
2018	2,100	53	.212
2019	2,000	50	.297
2020	**	55	.385
2021	2,200	53	.262
2022	**	22	.345
2006 – 2022	**28,800**	**638**	**.172**

Source: NEISS (2006-2022).
Estimates rounded to nearest 100; estimates that failed to meet NEISS publication criteria are presented as **.
Rows may not add to total due to rounding.

Table 5 presents a breakdown of the disposition of the injured patients. A large majority (71%) of the estimated injuries were categorized as “treated and released” or “examined and released without treatment”, while around 20% involved more serious injuries requiring hospitalization or additional observation.

Table 5: NEISS Estimates for Aerosol Duster Inhalation Injuries by Disposition

Disposition	Estimate	Sample Size
Treated and released, or Examined and released without treatment	20,300 (71%)	446
Treated and admitted for hospitalization, or Held for observation	5,800 (20%)	135
Left without being seen, or Left without treatment	2,400 (8%)	52
Death	** (<1%)	5
All Severities	**28,800**	**638**

Source: NEISS (2006-2022).
Estimates rounded to nearest 100; estimates that failed to meet NEISS publication criteria are presented as **.
Rows may not add to total due to rounding.

Table 6 presents an overview of the injuries based on age and gender. Around 63% of the estimated injuries occurred in males, and around 86% of estimated injuries occurred in patients between ages 18 and 54.

[85] According to the NEISS publication criteria, an estimate must be 1,200 or greater, the sample size must be 20 or greater, and the coefficient of variation (CV) must be 33 percent or smaller.

Table 6: NEISS Estimates for Aerosol Duster Inhalation Injuries by Age & Gender

Age Group (Years)	Male	Female	Total
0 – 17	2,000	1,700	**3,600 (13%)**
18 – 34	8,600	4,200	**12,800 (45%)**
35 – 54	7,500	4,200	**11,700 (41%)**
55 or older	**	**	**** (2%)**
Total	**18,200 (63%)**	**10,500 (37%)**	**28,800**

Source: NEISS (2006-2022).
Estimates rounded to nearest 100; estimates that failed to meet NEISS publication criteria are presented as **.
Rows may not add to total due to rounding.

Approximately 7,600 of the ED-treated estimated injuries (26%) occurred at a home. Another 7,500 estimated injuries (26%) took place at some public property, and 2,900 estimated injuries (10%) took place on a street or highway, at a school or at a place of recreation. The location for the remaining 10,700 estimated injuries (38%) was either unknown or not recorded.

Approximately 24,800 of the ED-treated estimated injuries (86%) were diagnosed primarily as poisonings, while the remaining 4,000 estimated injuries were diagnosed mostly as burns (chemical, thermal or unspecified), anoxia, contusions/abrasions, lacerations, or internal organ injuries.

Approximately 25,100 of the ED-treated estimated injuries (87%) were considered “whole body” injuries (i.e., no specific individual body part injured as a result of inhalation). Another 2,100 estimated injuries (7%) were classified as head, face or mouth injuries, while the remaining 1,600 estimated injuries (5%) were mostly classified as hand, lower arm or upper trunk injuries.

Consistent with the assertion made by the petitioner that aerosol duster abuse is associated with “auto accident fatalities where inhaling drivers hit pedestrians or other drivers,” readily available information from NEISS suggest dusters are abused/huffed in cars and while driving. Approximately 2,600 ED-treated estimated injuries (9%) involved the use of an aerosol duster in a motor vehicle.

III. CONCLUSION

For the CPSRMS data review, staff focused on incidents involving intentional inhalation of aerosol duster products, as well as fatal incidents caused by DFE toxicity; the previous data review in Spring 2022 only provided an incident analysis of aerosol duster inhalation incidents. The scope of the NEISS data review was unchanged. Staff reviewed incident data and injury estimates between 2006 and 2022, from CPSC’s CPSRMS and NEISS databases, respectively.

Due to the non-specificity of the NEISS narratives (i.e., lack of descriptive information on the product(s) and propellant(s) involved), the NEISS injury estimates should be considered as possible underestimates of the total number of ED-treated aerosol duster inhalation-related injuries. Similarly, the total number of aerosol duster inhalation incidents found in CPSRMS should be treated as an underestimate of the actual number of aerosol duster inhalation incidents in CPSRMS. It is likely that many of the of the DFE-related deaths can be attributed to inhaling aerosol duster products, as all of the DFE-related death reports that could be associated with other incidents in CPSRMS were related to fatalities caused by inhaling aerosol dusters; however, the true figure is unknown.

Staff identified:

- 1,210 incidents in CPSRMS related to aerosol duster inhalation, including 1,201 deaths, 6 non-fatal injuries and 3 non-injury cases. The majority of the CPSRMS incident data were sourced from death certificates and medical examiner and coroner reports. 979 (81%) of these 1,210 incidents took place between 2013 and 2022.
- 1,115 fatal incidents in CPSRMS related to DFE toxicity caused by an unspecified product or unidentified aerosol product. These incidents were all sourced from death certificates and medical examiner and coroner reports. 935 (84%) of the 1,115 incidents took place between 2013 and 2022.
- Approximately 70% of both the aerosol duster inhalation and DFE toxicity victims in CPSRMS were male, and over 90% of victims were between the ages of 18 – 54.
- An estimated 28,800 emergency department-treated injuries from aerosol duster inhalation based on a sample of 638 NEISS records. An estimated 22,500 of these injuries (78%) occurred between 2013 and 2022.
- An estimated 18,200 of the injuries (63%) occurred in males, and an estimated 24,500 of the injuries (86%) occurred amongst individuals ages 18 – 54 years.

TAB D: Aerosol Duster Petition: Alternative Mechanical Designs

United States
Consumer Product Safety Commission
cpsc.gov | info@cpsc.gov | 800.638.2772

Memorandum

TO: Chery Scorpio, Ph.D., Project Manager, Directorate of Health Sciences

DATE: July 26, 2023

THROUGH: Michael Nelson, Director, Division of Laboratory Sciences Mechanical

FROM: Matt Kresse, Mechanical Engineer, Division of Laboratory Sciences Mechanical

SUBJECT: Aerosol Duster Petition: Alternative Mechanical Designs

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Introduction

This memorandum discusses mechanical aerosol actuator designs that could prevent users from intentionally inhaling and abusing DFE or other toxic propellants found in aerosol duster products.

DFE is a common propellant used in aerosol dusters. DFE can be compressed into a liquid at a relatively low pressure at room temperature. Within the aerosol canister, DFE exists as a liquid and gas at the same time. After each burst of DFE gas released from the aerosol canister, a portion of the liquid DFE boils off and converts to a gas to maintain pressure within the canister. This process allows for consistent burst strength and longtime use of a single canister.

Actual air is not used in an aerosol canister because it is not practical for the common design of aerosol canisters currently sold. A canister filled with compressed air will only last for a few short bursts and lose its burst strength in a short time. To use a liquid/air combination, such as how DFE liquid/gas is used in aerosol dusters, would be impractical given the extreme pressure and temperature requirements to create this liquid/air combination. One alternative on the market is refillable spray dusters which use a Schrader valve (valve commonly found on automobile tires and some bicycle tires) to fill a canister up to 200 psi as shown below in Figure 1. This alternative would require an air compressor or manual air pump in order to refill as needed.

Figure 1: Refillable compressed air canister.

Another alternative design on the market currently is replaceable cartridge designs which use commonly available disposable CO_2 cartridges of various sizes, as shown below in Figure 2.

Figure 2: Replaceable CO_2 cartridge.

Discussion

Currently, aerosol dusters use different actuator designs. Figure 3 below shows two examples currently in use. The nozzle orifice of the actuator is a protrusion with an opening from which the DFE gas is released. In order to spray the DFE gas, the user needs to press on the trigger.

Figure 3: Current common aerosol single trigger actuator designs.

These actuator designs do not have a trigger locking mechanism that prevents product users from intentionally inhaling and abusing the DFE within.

Aerosol actuator designs do exist which are equipped with locking features to prevent accidental discharge. Figure 4 below shows a twist to lock/unlock design. The user can twist portion 510 about base 590 to either lock or unlock the trigger.

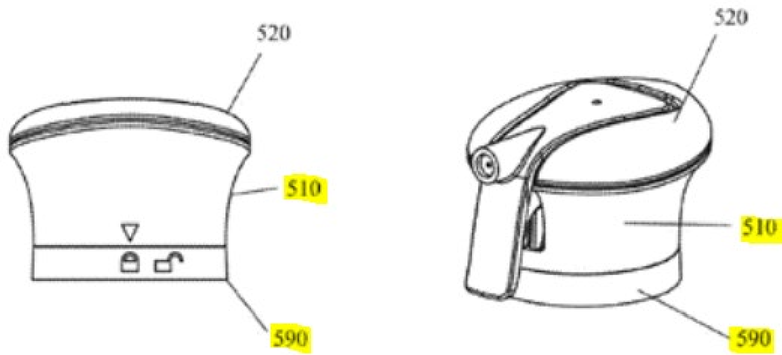

Figure 4: Twist to lock/unlock aerosol actuator design.

Another aerosol actuator design uses a straw to lock the trigger shown in Figure 5 below.

Figure 5: Straw lockout design.

Aerosol actuator lockout designs shown in Figures 4 and 5 are effective in preventing users from accidental pressing of the trigger while aerosol duster canisters are in storage. However, they are not effective in preventing users from intentionally inhaling and abusing the DFE. There are dual trigger designs where two independent triggers must be pressed in order to spray aerosol contents. Figure 6 below is an example of this design where both triggers 160 and 158 must be pressed simultaneously.

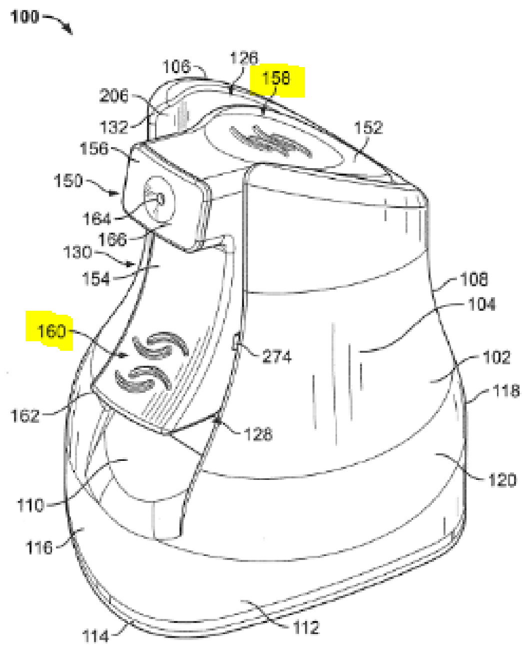

Figure 6: Dual trigger design.

While dual trigger designs may be effective in preventing accidental spraying of the contents while in storage or even prevent young children from accidental usage, they are not effective in preventing teenaged and adult users from intentionally inhaling and abusing the DFE from an aerosol duster.

Another possible design concept is modifying the trigger so that, when activated, only a short burst of the DFE is dispensed per activation. This trigger design can be locked by a timing device to prevent multiple bursts over a certain period of time. While this trigger design may be helpful in the prevention of inhaling DFE and the abuse of a single aerosol duster, it may not be effective when there are multiple aerosol dusters available to the user. Further, this would likely reduce the utility of the aerosol duster when it is used for dusting by preventing dusting users from using their aerosol duster as often or as long as intended.

Another conceptual design would be to have a lockable lid on the aerosol duster. Figure 7 below shows a sketch of an example where an aerosol duster would have a lid with an integrated locking device or a supplied padlock and key to prevent unauthorized use by others. The locking device would need to meet design requirements to prevent users from breaking the locking device. These design requirements would be dependent on the specific age range that owners are trying to prevent access to the product.

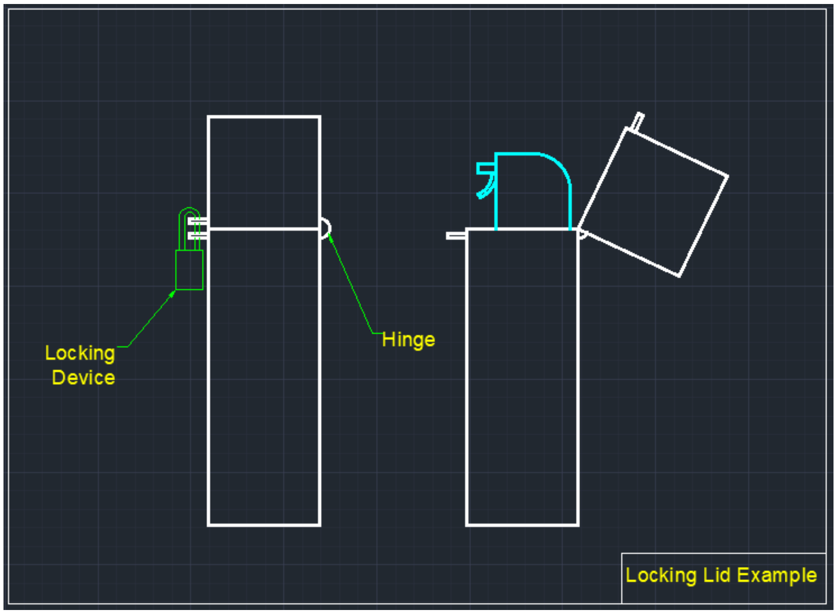

Figure 7: Concept of a pad lockable lid design.

This design may be useful in situations such as parents preventing teenagers from abusing aerosol dusters. However, this locking feature can be defeated with the use of basic tools. There is also nothing preventing teenagers or other adults from purchasing any other aerosol dusters in store or online.

Several alternative products to aerosol dusters exist. Figure 8 below shows an example of a battery operated and USB rechargeable device that blows air. It has several attachments that can be used for cleaning multiple surfaces and is a single device option serving as an alternative to purchasing multiple aerosol dusters.


Figure 8: Battery operated air blowing device.

A similar alternative product is shown below in Figure 9. This model is also battery operated and USB rechargeable. However, this model offers both a blower mode and an additional vacuum mode so the user can choose between blowing contaminants away or vacuuming them up.

Figure 9: Battery operated air blowing & vacuuming device.

Another possible alternative to aerosol dusters is to use and modify a 'Bag on Valve' (BOV) aerosol system. Currently, BOV canisters are used to spray a material formula such as liquid, gel or other ointment that is completely separated from the propellent gas. This is made possible by keeping the material formula contained within a bag and the bag contained within a canister surrounded by a propellant gas which squeezes the bag, shown below in Figure 10.

Figure 10: Visual of a BOV system.

This design could be modified to incorporate a DFE liquid/gas mixture as the contained propellent and use compressed air as the formula sprayed out. This design would have an advantage of maintaining the blowing force of the compressed air over time because the DFE boils off as the product is used. The DFE in this design concept would be contained and prevent access to the user and thus would be helpful in preventing intentional abuse and inhalation.

However, the lifetime use of this design would still be limited and dependent on the size of the canister and the bag within the canister. A typical aerosol duster canister of DFE would last much longer because DFE has the advantage of existing as a liquid and gas within the canister.

A further modification of the BOV system above would be to allow refilling of the bag using a check valve with compressed air as needed. While containing the propellent DFE within the canister a user would only need to refill the bag using an air compressor or air pump via the check valve. This conceptual design is not currently an available product, but it would allow a single canister to be reusable. However, the lifetime of each refill will be limited based on the size of the bag containing compressed air.

Testing

Testing of Refillable Air Can

Laboratory Sciences Mechanical (LSM) engineering staff acquired a 24 ounce (oz) refillable air canister having a Schrader valve and spray outlet diameter of 2.0 mm. While this canister has a maximum pressure of 200 psi (pounds per square inch), staff filled it to 100 psi for testing. The goal was to observe how many single second bursts the 24 oz canister could supply. It was found to produce 4-5 single second quality bursts before weakening at 20 psi remaining and needing refilled. If filled to the maximum 200 psi, the canister would likely produce 8-10 single second quality bursts before also weakening at 20 psi and needing refilling with either an air compressor or manual air pump.

If this same refillable 24 oz canister were instead a refillable BOV system, staff estimates that along with maintaining burst strength, the 20 psi remaining in a refillable canister could be used to produce an extra 1-2 single second bursts.

Testing of Battery-Operated Devices for Air Speed

Staff acquired battery operated and USB rechargeable duster devices. The goal was to compare air speeds, measured in meters/second (m/s), generated by the battery powered devices to the speeds generated by an aerosol duster. Three battery powered devices and two name-brand aerosol dusters were chosen for comparison.

Tables 1 and 2 below provide relevant information and specifications of each product.

Table 1: Information and Specifications of The Battery Powered Devices

Battery Powered Device	Battery Size (mAh)	Motor Speed (RPM)	Advertized Run Time (min)	Tested Nozzle Length (in.)	Tested Nozzle Orifice Diameter (in.)
Device #1	7600	91,000	Not Provided	2.75	0.25
Device #2	6000	3500	30	5.25	0.30
Device #3	6000	33,000	30	4.13	0.30

Table 2: Information and Specifications of The Aerosol Dusters

Aerosol Duster Brand	Net Weight (oz)	Tested Nozzle Length (in.)	Tested Nozzle Orifice Diameter (in.)
Brand #1	10	4.00	0.05
Brand #2	10	5.00	0.05

Testing of the battery powered devices was performed with the nozzle orifice located 6 in. away from a REED LM-8000 anemometer[86] which was calibrated during its manufacturing process at an ISO-9001 facility. The devices were set to their maximum speed setting and allowed to run for 30 seconds while the anemometer was set to record the maximum and minimum air speed generated. Table 3 below shows the performance results of each device.

Table 3: Battery Powered Devices Performance Results, Within 30 Second Time Frame

Battery Powered Device	Air Speed Max (m/s)	Air Speed Min (m/s)
Device #1	15.9	13.9
Device #2	12.2	10.5
Device #3	15.8	14.7

The results in Table 3 show each device maintained an air speed of no more than 2 m/s below the recorded maximum air speed over the 30 second time frame. This would be expected considering the motor's speed measured in revolutions per minute (RPM) would be maintained at a constant speed. Device #2, having a lower motor RPM of 3500 did not perform as well as the other two devices which each had a greater motor RPM of 91,000 and 33,000.

Testing of Aerosol Dusters for Air Speed

For the aerosol dusters, the testing was also performed with the nozzle orifice located 6 in. from the REED LM-8000 anemometer. Starting with a full canister, the trigger was pressed and held for 10 seconds while the anemometer was set to record the maximum and minimum speed.[87] This test was repeated for each canister at 75% full, 50% full and 25% full.[88] After recording the maximum and minimum air speeds at 75%, 50% and 25% full, each aerosol duster was allowed to sit for 10 seconds and then the trigger was pulled for an additional 10 seconds to have another maximum and minimum air speed recorded. Table 4 below shows the performance results of each aerosol duster.

[86] An anemometer is an instrument used for measuring the speed of wind, or of any current of gas.
[87] Staff did not test the air speed of aerosol dusters over a 30 second time frame.
[88] Both aerosol dusters were brought to each 'amount full' percentage and then given a minimum of 4 hours to allow the liquid DFE inside to boil into gas form and return to optimum pressure.

Table 4: Aerosol Duster Performance Results, at 10 Second Intervals

Aerosol Duster Brand	Air Speed Max (m/s)	Air Speed Min (m/s)	Additional 10s Air Speed Max	Additional 10s Air Speed Min (m/s)
Brand #1 (Full)	17.4	10.7	--	--
Brand #2 (Full)	16.2	11.8	--	--
Brand #1 (75% Full)	16.7	10.5	10.2	6.1
Brand #2 (75% Full)	15.7	10.0	9.1	5.5
Brand #1 (50% Full)	16.5	11.4	10.8	5.8
Brand #2 (50% Full)	14.0	9.7	9.5	5.1
Brand #1 (25% Full)	16.4	9.9	8.0	4.3
Brand #2 (25% Full)	14.1	7.8	7.7	3.5

Note: In the table above, "--" indicates not tested.

The results in Table 4 show that when an aerosol duster is given time to have its liquid DFE boil into gas form and return to optimum pressure, the maximum air speed performance does not lessen over its lifetime. A 25% full aerosol duster still generates an air speed of only 1.0-2.5 m/s less than a full one. However, the results show that the air speed decreases over the length of time the trigger is held per use. This is expected because the liquid DFE cannot boil fast enough to maintain the pressure within the aerosol duster. The instructions on aerosol dusters typically instruct the user to use only in short bursts in order maintain burst strength.

When comparing the performance results of battery powered dusters vs. aerosol dusters, the initial maximum air speeds (Air Speed Max (m/s)) measurements are comparable. Aerosol dusters tend to generate a slightly higher air speed, over short periods of time. However, a drawback to aerosol dusters is their long-term performance in a single use. The battery-operated duster designs can generate and maintain air speeds of 10-16 m/s over the life of the battery while the aerosol dusters produce usable air speeds for shorter periods of time and need time to allow their liquid DFE contents to boil into gas after 10-20 seconds of use in order to reach their max air speed potential.

A second drawback of aerosol dusters is their longevity. Because the battery powered dusters can be recharged, they can potentially last for years of use. In contrast, an aerosol duster has a limited amount liquid DFE and is designed for single use after which it is recycled or disposed of as solid waste. Therefore, aerosol dusters do not have the same longevity as battery powered dusters. Therefore, multiple aerosol dusters are needed for continued use. Accordingly, the cost of a single battery powered duster device may be more cost effective than the purchase of multiple aerosol dusters over time (See Economics Directorate memorandum (Tab E)).

Testing of Aerosol Dusters Trigger Pulls: Quantity Release (20 grams)

LSM staff also created a test to determine how many trigger pulls it takes to release 20 grams (g) of DFE. Twenty grams was chosen from a case in which the driver of a vehicle in an accident was found with two aerosol dusters: one unopened and the second weighing 20 grams less.[89] Two of a name-brand aerosol duster were used for the test where one was tested with the straw and the other was tested without the straw.

Each aerosol duster's trigger was squeezed for 2 seconds. They were then weighed and given 10 seconds before having the trigger squeezed for another 2 seconds. After a set of three trigger pulls, each aerosol duster was allowed to sit for 15-20 minutes before repeating the same trigger pulling pattern. This process was repeated until at least 20 grams were removed.

Table 5: Number of 2 Second Trigger Pulls to Remove 20 grams

	Test Results Using Straw	**Test Results Not Using Straw**
Original net Weight DFE (grams)	283	283
Number of 2 Second Bursts	11	5
Final DFE Weight (grams)	261.3	258.8
Avg Burst (grams)	1.97	4.84

After letting the aerosol dusters sit for 4 hours, each trigger was pulled for 5 seconds. They were then weighed before immediately pulling the trigger again for 5 seconds. This process was repeated until at least 20g were removed.

Table 6: Number of 5 Second Trigger Pulls to Remove 20 grams

	Test Results Using Straw	**Test Results Not Using Straw**
Starting net Weight DFE (grams)	261.3	258.8
Number of 5 Second Bursts	6	3
Final DFE Weight (grams)	240.2	236.2
Avg Burst (grams)	3.52	7.53

The results in Table 6 show that an abuser can inhale 20g of DFE from an unused canister with only three trigger pulls of 5 seconds each.

Conclusion

Staff concludes that because fatal incidents almost entirely involve teenagers and adults, that it is not feasible to address the hazard via lockout devices. The lid and trigger designs for aerosol dusters currently on the market are locking mechanisms intended to prevent accidental spraying and to keep young children from activating the trigger but are not effective for denying access to abusers of the product.

Staff concludes that battery powered air duster devices generate comparable air speeds to the propellant speeds of aerosol dusters. Results from testing quantities released from aerosol duster trigger pulls indicate that an abuser may inhale 20 grams of DFE from a single aerosol duster in three 5-second trigger pulls. However, during testing, each aerosol duster was allowed

[89]Tiscione, N. B., & Rohrig (2021). Journal of Analytical Toxicology; 1,1-Difluoroethane Forensic Aspects for the Toxicologist and Pathologist; 45:792–798.

to sit for a period of time before repeating the trigger pull test measurement. Therefore, the test method employed may overstate actual DFE dose for abuse of an aerosol duster.

References

CPSC Staff Briefing Package; Aerosol Dusters, 2022; 66.

Tiscione, N. B., & Rohrig (2021). Journal of Analytical Toxicology; 1,1-Difluoroethane Forensic Aspects for the Toxicologist and Pathologist; 45:792–798.

TAB E: Market and Economic Considerations for Petition Requesting the Commission Initiate Rulemaking to Adopt a Mandatory CPSC Safety Standard to Address the Hazards Associated with "Duster" Aerosol Products

United States
Consumer Product Safety Commission
cpsc.gov | info@cpsc.gov | 800.638.2772

Memorandum

TO: Cheryl Scorpio, Ph.D.,
Project Manager, Aerosol Duster Petition
Directorate of Health Sciences

DATE: July 26, 2023

THROUGH: Alex Moscoso
Associate Executive Director
Directorate for Economic Analysis

FROM: Cynthia Gillham and Jeffrey Giliam,
Economists
Directorate for Economic Analysis

SUBJECT: Market and Economic Considerations for Petition Requesting the Commission Initiate Rulemaking to Adopt a Mandatory CPSC Safety Standard to Address the Hazards Associated with "Duster" Aerosol Products

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I. INTRODUCTION

Commission Directive Implementing Procedure 302 for Petitions requires the Directorate for Economic Analysis to provide preliminary information on the following:

1. A brief discussion of market information. Staff will provide data on sales, product use, the number and size of firms, an estimate of product life, and the number of products in-use using readily available information from government, industry, or other sources.

2. A preliminary estimate of the annual cost to society of the hazard, if accurate information is readily available. Estimates of the annual societal cost include estimates on injuries from the CPSC injury cost model and other sources, property damage, and an assumed value per statistical life.

Accordingly, this memorandum provides information on the U.S. market for aerosol dusters and a preliminary estimate of the annual cost to society of the hazard posed by the products.

II. MARKET

To better understand the market for aerosol dusters, CPSC staff sponsored a contract to gather, update, or develop key market data for the aerosol duster market, to inform future decision-making regarding rulemaking. The contractors will draft a report of their findings, titled the ADP Market Report. The contractors will complete their work in July 2023, at which time the ADP Market Report can be made available.[90]

In this memorandum, staff provides readily available information and draft findings of the ADP Market Report, including information on sales, product use, the number and size of firms, an estimated product life, and the number of products in use.

II.A. Aerosol Duster Description

Size. Aerosol dusters are sold in aerosol cans for consumer use. Commonly, aerosol dusters are sold as a 10 oz. can with a trigger nozzle head. (See Figure 1.) Aerosol dusters are also available from retailers in 3.5 oz., 8 oz., and other sizes.

Figure 1: Aerosol Duster Product

[90] Data from the ADP Market Report will include information on aerosol duster products that use DFE and alternative propellants, in-store and online product audits, and primary interviews from trade and industry experts.

Aerosol dusters are sold as individual canisters and in multipacks. According to preliminary findings from the ADP Market Report, aerosol dusters are commonly sold as single canisters, in 2-packs and in 6-packs.

Propellant. An aerosol duster contains a propellant that is used to clean dust and debris from keyboards, electronics, or other items. Propellant in the can exists in an equilibrium between a liquid and gas phase and is released as a gas. According to aerosol duster Safety Data Sheets[91], difluoroethane (CAS No. 75-37-6), also known as DFE or HFC-152a, is the most commonly used propellant in consumer aerosol dusters.[92] The second most commonly used propellant in aerosol dusters is 1,1,1,2-tetrafluoroethane (CAS No. 811-97-2), also known as HFC-134a, which can be used alone or in mixture with difluoroethane.[93] HFC-152a and HFC-134a are hydrofluorocarbon propellants.[94] A third propellant that is less commonly used, trans-1,3,3,3-tetrafluoropropene (CAS No. 29118-24-9), is also called HFO-1234ze.[95]

Bitterant. According to preliminary findings from the ADP Market Report, the majority of aerosol dusters sold in stores, that are intended for household use, contain an additive bitterant. Use of an additive bitterant may not be noted on the product's Safety Data Sheet, nor is the concentration of bitterant used in the product specified.

Aerosol dusters that contain an additive bitterant are not uniformly labeled on the product, but may contain some variation of the following text:

> *Contains a bitterant to help discourage inhalant abuse.*

This text is typically found on the front, side, or back of the product, or in some combination of these locations.

Warnings against inhalation abuse can be found on most aerosol duster products. However, such warnings are less common on seller's websites (See table 1.) Preliminary findings from the ADP Market Report indicate that on-product information and warnings are more complete than the information and warnings provided on seller's websites. Additional information on the size and placement of inhalation warnings on aerosol dusters will be made available in the ADP Market Report.

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[91] The Occupational Safety and Health Administration's Hazard Communication Standard (29 CFR 1910.1200(g)) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets for hazardous chemicals to downstream users (https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf).

[92] Safety Data Sheets do not typically specify the exact concentration of propellant used alone or in mixture in aerosol duster products.

[93] According to preliminary data from the ADP Market Report, 87 percent of aerosol duster products use HFC-152a (i.e., DFE) as the propellant. Eleven percent of aerosol duster products use HFC-134a (i.e., tetrafluoroethene), and 1 percent use HFO-1234ze. An additional 1 percent of aerosol duster products use a mixture of HFC-152a and HFC-134a in a non-flammable blend.

[94] According to information published by the Household & Commercial Products Association, hydrofluorocarbons came into use as a replacement for chlorofluorocarbons (CFCs) because they do not deplete the ozone layer.

[95] HFO-1234ze was introduced by industry within the past ten years and is advertised as an eco-friendly alternative in consumer aerosol duster products, with "ultra-low Global Warming Potential (GWP)". (TechSpray, 2023)

In the July 2022 staff briefing package for aerosol dusters, staff in the Directorate for Engineering Sciences, Division of Human Factors (ESHF) concluded that a warning label alerting consumers to the hazard of intentionally abusing aerosol dusters could lead to the very behavior the label is intended to protect against. Upon review of the preliminary information available from the draft ADP Market Report, ESHF staff did not identify any new information that would contradict their previous conclusion. In consultation with staff in the Directorate for Economic Analysis, ESHF staff find that the development of a performance standard for warning label language or warning label placement would not have a significant impact on the misuse or abuse of aerosol dusters.

The use of a bitterant is typically mentioned on the product but may also be mentioned online. The term "Air" is not commonly found on aerosol dusters, however in stores these products are commonly referred to as "canned air" by sales associates.[96] The term "Air" is also used in many online descriptions for these products.

Table 1: Preliminary summary findings of product warnings, percent estimates

Distribution Channel	Term "Bitterant" mentioned online	Terms "Inhalation" or "Abuse" mentioned online	Term "Air" used in online descriptions
Online retailers, only	48%	45%	40%
Omnichannel retailers (retailers with both in-store and online product sales)	59%	52%	49%

Distribution Channel	Term "Bitterant" mentioned on canister	Terms "Inhalation" or "Abuse" mentioned on canister	Term "Air" used on canister
In-store retailers, only	84%	88%	0%

Source: Euromonitor International (April 10, 2023). EMI-USCPSC Interim Project Update.

II.B. Marketed Uses

Producers design and intend aerosol dusters to be used for multiple purposes by consumers. Many aerosol dusters are labeled for "electronics dusting," or more generically, as a "multi-purpose duster." Aerosol dusters are marketed for dusting laptops, keyboards, computers, TVs, phones, printers, electronic toys, gaming devices, and other common household electronic

[96] During in-store audits, retail sales associates sometimes referred to ADPs as "canned air". ADPs are occasionally labeled as "canned air" in self-checkout screen descriptions.

products. Aerosol dusters can be sold for other household uses such as the removal of dust or debris from sewing machines, clocks, watches, musical instruments, or auto detailing.

Manufacturers and distributors of aerosol dusters may also supply similar products marketed for a different use that also use DFE as a propellant. For example, Falcon Safety Products, a manufacturer and supplier of aerosol dusters, also manufactures and sells a product called "Sound Alert." The product is a 6 oz. can containing DFE (CAS No. 75-37-6) used as a hand-held signaling device.

Similarly, manufacturers and distributors of aerosol dusters may also supply products that use a propellant, such as HFC-134a (CAS No. 811-97-2), that are used for cooling electronics. For example, Chemtronics, a manufacturer and supplier of aerosol dusters, also distributes "freeze spray" in a 10 oz. canister with a trigger head that is used to cool electronic components like circuit boards.

II.C. Market Information

Aerosol dusters are available for purchase from a variety of in-store and online retail locations, including office-supply stores, hardware stores, home-electronics stores, auto-supply stores, grocery stores, and pharmacies. (See Table 2.)

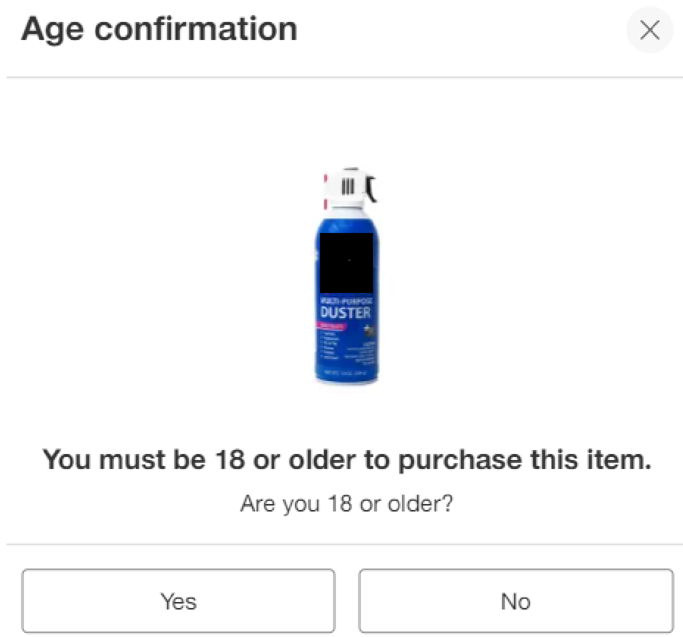
Table 2: In-Store and Online Aerosol Duster Retailers

E-commerce	Clubs and Hypermarkets	Grocery Stores and Pharmacies	Office, Hardware and Electronics	Other
Amazon	BJ's	CVS	Ace Hardware	Big Lots
Grainger	Costco	Fred Meyer	Best Buy	Dollar General
Instacart	Meijer	Harris Teeter	Home Depot	O'Reilly Auto Parts
Kimball Midwest	Sam's Club	Kroger	Lowe's	
Newegg	Target	Walgreens	Menards	
Uline	Walmart	Wegman's	Office Max/Depot	
WB Mason			Staples	

Source: Preliminary data collected from in-store visits and an online review of products, under the CPSC-sponsored ADP Market contract.

Display and Restrictions. In retail stores, aerosol dusters for consumer use are available on shelves, typically in the consumer electronics section. Aerosol dusters are also found in locked shelves or behind the counter, where a sales associate must assist the consumer to access the product in store. In various U.S. States, aerosol dusters may be restricted for use to consumers over age 18 and must present a valid form of identification. Online, consumers may be asked to verify they are age 18 or older before purchasing an aerosol duster. (See figure 2.)

Figure 2: Online Age Confirmation



Product life. Aerosol dusters are sold without an expiration date printed on the canister and may have a relatively long shelf life. According to preliminary data collected for the ADP Market Report, the product warranty may be limited to 1 year.

Sales. In the previous briefing package submitted to the Commission in 2022, staff estimated that approximately 20 million canisters of aerosol duster products are sold each year and that industry sales are approximately $160 million per year. Staff derived this estimate by analyzing revenues of market-leading firms with information from the Household & Commercial Products Association (HCPA) annual survey of aerosol pressurized products. Preliminary information collected for the ADP Market Report confirmed these estimates correctly approximate the size of the U.S. market for aerosol dusters. However, at the time this memorandum was written, the ADP Market Report had not yet been finalized.

HCPA estimates that 3.75 billion aerosol cans were filled in the United States in 2020 for use by commercial and industrial facilities as well as by households.[97] If 20 million cans of aerosol dusters are sold each year, it would represent less than one percent of the total number of aerosol cans produced annually.

Number and Size of Firms. Preliminary data from the ADP Market Report identifies 22 suppliers of aerosol dusters. The majority of these firms would be considered small, according to Small Business Administration (SBA) guidelines.[98] The North American Industry Classification System (NAICS) codes pertaining to aerosol duster manufacture, import and retail are provided in Table 3.

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[97] https://www.thehcpa.org/wp-content/uploads/2021/06/2020-Aerosol-Pressurized-Products-Survey-Press-Release.pdf
[98] https://www.sba.gov/document/support-table-size-standards

Table 3: Aerosol Duster NAICS Sectors

NAICS Code	NAICS Description	Size Standard in number of employees	Number of total establishments[1]
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	650	1,242
424690	Other Chemical and Allied Products Merchant Wholesalers	175	9,297

NAICS Code	NAICS Description	Size Standard in millions ($)	Number of total establishments[1]
441330	Automotive Parts and Accessories Retailers	$28.5	38,281
444110	Home Centers	$47.0	5,969
444140	Hardware Retailers	$16.5	15,099
445110	Supermarkets and Other Grocery Retailers (except Convenience Retailers)	$40.0	62,329
445131	Convenience Retailers	$36.5	34,170
449210	Electronics and Appliance Retailers	$40.0	16,797
455211	Warehouse Clubs and Supercenters	$47.0	8,070
456110	Pharmacies and Drug Retailers	$37.5	43,879
459110	Sporting Goods Retailers	$26.5	19,976
459410	Office Supplies and Stationery Retailers	$40.0	4,475

[1] U.S. Census Bureau, County Business Patterns, 2021, all establishments.

II.D. Competing Products and Substitutes

The ADP Market Report will characterize suitable alternatives and substitutes for aerosol dusters that are currently available to consumers. Examples of alternatives include electronic compressed-air dusters and vacuums. The ADP Market Report will provide details on the prices and variety of electronic compressed-air dusters available to consumers.[99]

According to readily available data retrieved from the internet in July 2022[100] and March 2023,[101] electronic air dusters consistently compete with aerosol dusters as "the best-selling compressed air dusters". Electronic compressed-air dusters are advertised as an alternative to

[99] According to readily available data on the internet electronic compressed-air dusters may retail from $40 to $80.
[100] https://www.amazon.com/Best-Sellers-Compressed-Air-Dusters/zgbs/pc/3012916011 (visited 5 July 2022).
[101] https://www.bestreviews.guide/compressed-air-dusters-for-computers (visited 22 March 2023).

aerosol dusters, suitable for cleaning electronics, with a variety of additional product functions including:

- Strong, non-diminishing, air flow that can be used for dusting for long periods
- Rechargeable, for repeated use
- May provide both a blown-air and vacuum air function
- Adjustable settings (e.g., high, medium, and low) for greater control
- May come with brushes and nozzles as attachments for cleaning
- May include a light to illuminate the area or electronics being cleaned
- Can be used to inflate other products, such as air mattresses

According to online product reviews, electronic compressed-air dusters are typically more expensive than aerosol dusters. However, the up-front higher cost of purchasing an electronic compressed-air duster, over the product lifespan, could result in a net savings compared with regular and repeated purchasing of disposable single-use aerosol dusters. Electronic compressed-air dusters may also be preferred by consumers because of the lack of propellant and their ability to provide continuous, strong, and non-diminishing blown air.[102] However, product reviewers note that electronic air dusters can be loud.

III. SOCIETAL COSTS OF AEROSOL DUSTERS

The Commission Directive Implementing Procedure 302 for Petitions requires the Directorate for Economic Analysis to provide a preliminary estimate of the annual cost to society of the hazard. Estimates of the annual societal cost presented below include estimates on injuries from the injury cost model (ICM) and fatalities at an assumed value per statistical life (VSL). The ranges reflect the lower estimates which only contain known aerosol duster fatalities and the larger estimates which also include fatalities attributed to DFE.

The total cost to society from aerosol duster injuries and fatalities is estimated to range from $1.031 billion to $1.837 billion per year.

- The estimated annual cost to society from fatalities ranges from $868 million to $1.674 billion per year.
- The estimated annual cost to society from injuries is $163 million per year.

Spreading the total societal costs across approximately 20 million cans of aerosol dusters sold every year gives results in an estimated cost of approximately $50 to $90 per can.

III.A. Estimate of the Annual Cost to Society from Fatalities

Between 2006 and 2022, CPSC received reports for 1,201 unique fatal incidents involving inhalation hazards for aerosol dusters. (See epidemiology memorandum, Tab C). To estimate the societal costs of deaths, staff applied the VSL. VSL is an estimate used in benefit-cost analysis to place a value on reductions in the likelihood of premature deaths (OMB, 2003). The VSL does not place a value on individual lives, but rather, it represents an extrapolated

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[102] Propellant can sometimes leak from ADPs onto computer electronics. The blast of 'air' from an ADP will diminish. For these reasons, product reviewers note that electronic compressed-air dusters are preferable to ADPs because they will not leak propellant and can maintain a steady air flow.

estimate, based on the rate at which individuals trade money for small changes in mortality risk (OMB, 2003). This is a "willingness to pay" methodology which attempts to measure how much individuals are willing to pay for a small reduction in their own mortality risks, or how much additional compensation they would require to accept slightly higher mortality risks.

For this analysis, staff applied estimates of the VSL developed by the U.S. Department of Health and Human Services (HHS). The HHS estimate of the VSL when adjusted for inflation and growth in real income, consistent with HHS guidelines,[103] is $12.29 million for 2022.[104] Using a VSL of $12.29 million,[105] the estimated annual cost to society from fatalities (in 2022 dollars) ranges from $868 million to $1.837 billion per year. This estimate assumes roughly 70 to 136 deaths per year from aerosol duster abuse.[106]

III.B. Estimate of the Annual Cost to Society from Injury

The Directorate for Epidemiology (EP) retrieved casualties reported through the National Electronic Injury Surveillance System (NEISS), a national probability sample of U.S. hospital emergency departments (ED). Staff used NEISS to identify estimates of aerosol duster inhalation injuries in hospital admissions via ED. (See Tab C, table 5 for NEISS estimates of aerosol duster inhalation injuries by disposition.) Next, staff used these NEISS incidents and the ICM to extrapolate and generate national estimates for injuries from aerosol duster abuse treated in the ED and other settings. The ICM estimated 73,129 aggregate nonfatal injuries from aerosol duster abuse from 2006 to 2022. The ICM estimates that from the 73,129 injuries, 42,678 were treated in an outpatient setting (e.g., doctor's office, or clinic), 22,825 resulted in ED treatment, 5,836 resulted in hospital admissions via the ED, and 1,790 resulted in direct hospital admissions.

Staff estimated the societal costs of nonfatal injuries using the ICM. Societal cost components include medical costs, work losses, and the intangible costs associated with pain and suffering (Lawrence et al., 2018). (See table 4.)

Medical costs include three categories of expenditures: (1) medical and hospital costs associated with treating the injured victim during the initial recovery period and in the long run, including the costs associated with corrective surgery, the treatment of chronic injuries, and rehabilitation services; (2) ancillary costs, such as costs for prescriptions, medical equipment, and ambulance transport; and (3) costs of health insurance claims processing. The ICM derives

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[103] U.S. Health and Human Services, "Appendix D: Updating Value per Statistical Life (VSL) Estimates for Inflation and Changes in Real Income", Figure D.1., April 2021, https://aspe.hhs.gov/sites/default/files/2021-07/hhs-guidelines-appendix-d-vsl-update.pdf.
[104] Ibid. Original 2013 VSL estimate of $9.0 million was adjusted to 2022 using a factor of 1.256262 (292.655 ÷ 232.957, CPI-U indices for 2022 and 2013, Series Id: CUUR0000SA0) for inflation, and 1.087087 (362 ÷333, Weekly and hourly earnings data from the Current Population Survey Indices for 2022 and 2013, Series Id: LEU0252881600).
[105] Used the VSL estimate from U.S. Department of Health and Human Services (HHS) of $9 million in 2013 dollars and adjusted for inflation into 2022 dollars and for changes to real income since 2013. Staff followed the methodology and sources set forth in HHS's VSL adjustment guideline found here: https://aspe.hhs.gov/reports/updating-vsl-estimates
[106] The lower estimate limits itself to aerosol duster fatalities: 1,201 deaths ÷ 17 years = 70.6 deaths per year. Including DFE fatalities gives the higher estimate: (1,201 + 1,115) ÷ 17 years = 136.2 deaths per year.

cost estimates for these expenditure categories from several national and state databases, including the Medical Expenditure Panel Survey (MEPS), the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP-NIS), the Nationwide Emergency Department Sample (NEDS), the National Nursing Home Survey (NNHS), MarketScan® claims data, and a variety of other federal, state, and private databases.

Work loss estimates include: (1) the forgone earnings of the victim, including lost wage work and household work; (2) the forgone earnings of parents and visitors, including lost wage work and household work; (3) imputed long-term work losses of the victim that would be associated with permanent impairment; and (4) employer productivity losses, such as the costs incurred when employers spend time rearranging schedules or training replacement workers. The ICM bases these estimates on information from the MEPS, the Detailed Claim Information (a workers' compensation database) maintained by the National Council on Compensation Insurance, the National Health Interview Survey, the U.S. Bureau of Labor Statistics, and other sources.

The intangible costs of injury reflect the physical and emotional trauma of injury, as well as the mental anguish of victims and caregivers. Intangible costs are difficult to quantify because they do not represent products or resources traded in the marketplace. The ICM develops a monetary estimate of these intangible costs from jury awards for pain and suffering. The ICM derives these estimates from a regression analysis of jury awards in nonfatal product liability cases involving consumer products compiled by Jury Verdicts Research, Inc. Table 4 shows the aggregate cost of each categorized nonfatal injury under an annualized basis, which is derived from historical incidents and cost estimates from the ICM.

Table 4: Estimated (annualized) Cost for Medically Treated Nonfatal ADP Injuries ($ Millions)

Place of Treatment	Medical Cost	Work Loss	Pain & Suffering	Total Cost
Doctor/Clinic	$1.25	$3.43	$41.0	$45.7
Emergency Department (ED)	$2.81	$1.86	$31.7	$36.4
Hospital – Direct Admission	$2.46	$4.37	$13.1	$19.9
Hospital – Admission via ED	$8.05	$14.69	$38.5	$61.3
TOTAL	$1.25	$3.43	$41.0	$45.7

The ICM estimates that each year the costs (in 2022 dollars) associated with nonfatal aerosol duster injuries are: $45.72 million for injuries treated at the doctor's office/clinic, $36.40 million for injuries treated at the emergency department, $19.89 million for injuries with direct hospital admissions, and $61.26 million for injuries that result in hospital admission via ED. Therefore, on an annual basis, the total cost of nonfatal aerosol duster injury is approximately $163 million per year.

III.C. Estimating the Market for Abuse

There is overwhelming evidence, including hospital records, and reported deaths, that some consumers abuse aerosol dusters as inhalants for intoxication. Therefore, some sales to consumers are to individuals that intend to abuse the aerosol duster product. However, estimating the number of aerosol dusters that are purchased for the purpose of substance abuse is difficult given the clandestine nature of the activity.

Staff used The National Survey on Drug Use and Health (2015-2019) data to estimate how many Americans have ever used aerosol dusters for intoxication.[107] Using similar data for general inhalant abuse,[108] preliminarily staff estimates that 86,000 Americans abuse aerosol dusters every month and 269,000 per year. (See Table 5.) However, these estimates are made with a high degree of uncertainty.

Table 5: Estimates of ADP Substance Abuse

Age Group	Abused Aerosol Dusters Within the Last Month	Abused Aerosol Dusters Within the Last Year	Abused Aerosol Dusters Within Lifetime
17 under	15,000	54,000	195,000
18 to 25	31,000	114,000	703,000
26 to 34	29,000	79,000	1,117,000
35 to 49	11,000	19,000	668,000
50 up	1,000	2,000	109,000
Total	86,000	269,000	2,790,000

Note that columns may not sum due to rounding.

III.D. Potential Drug Substitutes

Due to the presence of drug substitutes (see, e.g., Tab A for discussion on this topic), it is unclear to what extent the requested regulatory action would prevent deaths or prevent

[107] https://pdas.samhsa.gov/#/survey/NSDUH-2002-2019-DS0001/crosstab/?recodes=AIRDUSTER2_RECODE%7C0%3D0%261%3D1&results_received=true&row=AIRDUSTER2_RECODE&run_chisq=false&weight=ANALWC5
[108] https://pdas.samhsa.gov/#/survey/NSDUH-2002-2019-DS0001/crosstab/?results_received=true&row=INHALREC&run_chisq=false&weight=ANALWC5

injuries.[109] However, given the number of deaths associated with aerosol duster abuse, regulation of these products may be cost beneficial.

III.E. Other Costs

The estimated annual cost to society of the hazard should include estimates on injuries from other sources and property damage. Consistent with the assertion made by the petitioner that aerosol duster abuse is associated with "auto accident fatalities where inhaling drivers hit pedestrians or other drivers," NEISS data suggest aerosol dusters are abuse/huffed in cars and while driving.

ICM cost estimates of the available data do not include property damage. Data reviewed from NEISS and CPSRMS only involve the injuries and fatalities of aerosol duster abusers, and therefore may underestimate the societal cost of the hazard.

Available data underestimate the cost of:

- injuries and fatalities to bystanders, pedestrians and other drivers
- private and public property damage, such as damage to other vehicles, and roadway structures (e.g., walls, medians, mailboxes, etc.)

In the June 2021 petition, the petitioner provides a list of "huffing" cases reported in the local news.[110] The petitioner identified fourteen incidents across the country of huffing between May 21, 2018 to July 11, 2018. Nine of the cases identified by the petitioner involve a parked car or a car in motion.

Anecdotal data provided by the petitioner reflect incident narratives available from NEISS Data collected by CPSC, between 2006 and 2020.

Though not captured in the available injury and fatality data, costs for bystanders struck by abusers of aerosol dusters while operating a motor vehicle, could be significant. Property damage to high-priced items, like motor vehicles, may also be substantive, but is likely smaller than the societal cost from death and injuries.

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[109] See Alpert, A., Powell, D., & Pacula, R. L. (2018). Supply-side drug policy in the presence of substitutes: Evidence from the introduction of abuse-deterrent opioids. American Economic Journal: Economic Policy, 10(4), 1-35.
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[110] https://www.regulations.gov/document/CPSC-2021-0015-0002

IV. CONCLUSIONS

In this memorandum, staff provides readily available information and draft findings of the ADP Market Report.

Aerosol duster products can be identified by key product attributes, such as canister size, nozzle type, propellants used, and occasionally the addition of a bitterant, in combination with a description of their intended product use. Many aerosol dusters are labeled for “electronics dusting”, or more generically, as a “multi-purpose duster”. However, other products with similar key product attributes are marketed and sold to consumers for a different use, such as freeze spray or sound signaling. Aerosol dusters compete with suitable alternatives and substitutes for electronics dusting that are currently available to consumers. Examples of alternatives include electronic compressed-air dusters and vacuums.

Preliminary findings indicate that on-product information and warnings on aerosol duster canisters are more complete than product information and warnings provided to consumers online. Warnings against inhalation abuse can be found on most aerosol dusters. The term “Air” is not commonly found directly on aerosol dusters; however, it is used in many online descriptions for the product.

The three most commonly used propellants in aerosol dusters are HFC-152a (DFE), HFC-134a (1,1,1,2-tetrafluoroethane), and HFO-1234ze (trans-1,3,3,3-tetrafluoropropene). If products with a different propellant, such as HFC-134a (1,1,1,2-tetrafluoroethane, CAS No. 811-97-2) or HFO-1234ze (trans-1,3,3,3-tetrafluoropropene, CAS No. 29118-24-0), were excluded from the scope of a future rulemaking, any hazard reduction benefits of the rule would be limited as manufacturers could change the formulation of the product to be outside the scope of the rule.

Preliminarily, staff estimates that 86,000 Americans abuse aerosol dusters every month and 269,000 per year, although this estimate is made with a high degree of uncertainty.

The total cost to society from aerosol duster injuries and fatalities is estimated to range from $1.031 billion to $1.837 billion per year, with an estimated cost of $50 to $90 per canister produced. The estimated annual cost to society from fatalities is $868 million to $1.674 billion per year. The estimated annual cost to society from injuries is $163 million per year. These estimates do not include property damage and therefore may underestimate the societal cost of the hazard.

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