Bayesian Estimate of Federal Agents' Use of $ZnCl_2$ Gas Against Black Lives Matter Protesters

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Abstract

Law enforcement's use of chemical weapons is a threat to human and environmental health, exemplified during 2020 Black Lives Matter (BLM) protests in Portland, OR, where city, county, state, and federal agencies have deployed various chemicals for over 100 days. In the second half of July, Department of Homeland Security (DHS) agents used an exceptionally toxic and unknown weapon to quell free speech in support of Black lives and against federal presence. With significant support from the community, I combined first-hand accounts, media reports, videos and photos of munitions, primary literature and analytical chemistry to identify the weapon as gaseous Zinc Chloride ($ZnCl_2$) from so-called Hexachloroethane (HC) "smoke" grenades. I then used hierarchical Bayesian methods to estimate that DHS deployed 24 (23 - 27) HC grenades in July. The gas released is so toxic that the grenades deployed produced enough $ZnCl_2$ to kill the author (~100 kg) 137 (131 - 154) times over and its release has led to persistent major health issues in the exposed population. Given prior case histories of $ZnCl_2$ exposure and novel symptoms associated with HC grenade use by DHS, $ZnCl_2$ is certainly the causal agent and has created an ongoing human and environmental health crisis extending well beyond the protests' footprint. DHS's wanton use of $ZnCl_2$ against protesters will have lasting impacts for decades and was identified through a community of civilians standing up to say Black Lives Matter.

Keywords

Black Lives Matter, Chemical Weapons, Hexachloroethane, Hierarchical Bayes, Metal Fume Fever, Police Brutality, Zinc Poisoning

Introduction

"The use of poison in any manner, be it to poison wells, or food, or arms, is wholly excluded from modern warfare. He that uses it puts himself out of the pale of the law and usages of war."

- General Orders No. 100, Article 70, signed President Abraham Lincoln 1863

Following the murder of George Floyd in Minneapolis Minnesota on 2020-05-25, Black Lives Matter (BLM) protesters took to the streets around the world to demand justice (Morman et al 2020). In present-day Portland Oregon (on traditional land of Chinook, Clackamas, Cowlitz, Kalapuya, Kathlamet, Molalla, Multnomah, Tualatin, and Wasco Tribes), BLM protests have continued for over a hundred days, only interrupted by hazardous wildfire smoke (Appendix 1). In response to gatherings, various law enforcement agencies have deployed chemical weapons, building upon a legacy of chemical weapons usage by Portland Police Bureau (Morman et al.

2020). Indeed, as of September 25th, Portland currently has the most instances of police brutality among US cities (regardless of size) (363 of the 1,147; New York City is the next highest with 102) and a disproportionate rate of chemical attacks (45% vs 40% in all other cities combined) (Appendix 2).

Although they were outlawed for American wartime use by Abraham Lincoln via the Lieber Code in 1863 and internationally in the Hague Conventions of 1899 and 1907 as well as the Geneva Protocol of 1928, chemical weapons have a long history of use by law enforcement against civilians to quell unrest (Hu et al. 1989; Appendix 1). This occurs despite chemical weapons being fundamentally indiscriminate, often deployed against specifications, and lethal (Hu et al. 1989). In the United States, the use of chemical weapons against protesters exacerbates systemic inequities and limits constitutionally protected expression of speech and assembly (Morman et al. 2020). For example, in Portland, law enforcement only deploys chemical weapons to prevent free speech in support of Black lives; no such actions are taken against recognized white supremacist hate groups (Morman et al. 2020).

During the second half of July, as interest in Portland's BLM protests was resurging and focused particularly on federal presence (Fig. 1), agents of the US Department of Homeland Security's (DHS) new Protecting American Cities Task Force (PACTF) deployed deadly gaseous Zinc Chloride ($ZnCl_2$) via Hexachloroethane (HC) Smoke grenades (Fig. 2). At the time, $ZnCl_2$ was not a familiar chemical weapon nor were HC cans among any recovered munitions (Appendix 1). Indeed, it took an incredible effort by frontline journalists, scientists, community leaders, legal observers, medics, and protesters to document the munitions so that HC use could be definitively identified, tied to DHS use, and connected to production by Defense Technology, a subsidiary of The Safariland Group (Fig. 2, Appendices 1 and 2).

Hexachloroethane is a munitions "smoke" developed in the early 1930s by US Army Chemical Warfare Service that was understood by the mid-1940s to be a poisonous chemical agent (Cullumbine 1957, Novak et al. 1987, Eaton et al. 1994), and which has since been replaced throughout the military (Blaue and Seidner 2012). HC itself is listed as hazardous by the International Agency for Research on Cancer, Environmental Protection Agency, Department of Transportation, Occupational Safety and Health Administration, American Conference of Governmental Industrial Hygienists, National Institute for Occupational Safety and Health, and National Toxicology Program (Smith-Simon et al. 1997) and has significant human and environmental health consequences. A more dire result of the use of HC grenades, however, is that they produce a highly lethal combination of gaseous products including the dominant (> 75%) constituent $ZnCl_2$, and additional noxious components such as carbon monoxide (CO), phosgene ($COCl_2$), hexachlorobenzene (C_6Cl_6), tetrachloroethene (C_2Cl_4), carbon tetrachloride (CCl_4), hydrogen chloride (HCl) and chlorine (Cl_2) gasses based on temperature and humidity (Dainton and Ivin 1947, Archer 1979, Shaw et al. 2016).

Indeed, hundreds of cases of toxicity from HC smoke have been documented across the intervening decades, showing a range of significant symptoms including immediate dyspnoea, coughing, lacrimation, chest pain, vomiting, nausea, and mucosal irritation; delayed and

prolonged inflammation of skin and internal organs as well as tachycardia; chronic genotoxicity of the bronchial epithelium; and an average fatality rate of 0.14 among case clusters (Idrissi et al. 2017; Appendix 2). HC smoke has further significant effects on the environment, including defoliation and long-term reduction in tree growth (Hartl et al. 2019) and stunted bone development and bioaccumulation in fish (Davidson et al. 1988, Nichols et al. 1991, Salvaggio et al. 2016). Given the lethality of its products, the wanton use of HC by DHS in Portland is incredibly alarming and warrants significant further investigation.

As a starting point, I derive here forensic-based Bayesian estimates of HC use (Appendix 2). Such an exercise would not be necessary if DHS were to release actual chemical weapons deployment data, but given the lack of transparency regarding chemical weapons use by all law enforcement agencies in Portland, including retrieval of canisters to prevent identification (Appendix 1), an estimation of HC use is a critical starting point to understanding the scope and scale of its impacts. Having collated a large dossier of photographs, videos, archived live streams, available Twitter, print media, and news aggregators (Appendices 1 and 2), I identified deployments of HC and recovery of munitions during July (Appendix 2). I also estimated the time federal agents were out of their buildings and crowd size for each day from this data set. I combined these data using hierarchical Bayesian regression to estimate the number of cans of hexachloroethane deployed each day and over the course of the month (Appendix 2). I then translated this total number of canisters deployed to human fatality potential focusing on $ZnCl_2$ (Eaton et al. 1995, Blau and Sneider 2012, Shaw et al. 2016; Appendix 2).

Over the course of July 2020, DHS deployed an estimated 24 (23 - 27, 95% posterior interval) cans of hexachloroethane in the immediate vicinity of the Wyatt Federal Building and the Hatfield Federal Courthouse in downtown Portland Oregon. Based on actual recoveries (Fig. 2), the definitive minimum number of cans is 17, six more canisters were observed being deployed by agents but were not recovered. Translation of the estimated HC deployment to $ZnCl_2$ gas shows that the number of fatalities that could have occurred was 137 (131 – 154, 95% posterior interval). Although the canisters were deployed outside, which certainly prevented many deaths, diffusion was limited by crowds of thousands of people (Fig. 1), closed tree canopies, cars, and tents. Indeed, the off-gassing $ZnCl_2$ presented significant risks to individuals in the vicinity as evidenced by high levels of zinc in environmental samples, acute and chronic symptoms, and odors detectable miles away (Appendix 1).

Under ideal conditions (open field), the concentration of $ZnCl_2$ produced by a typical HC grenade is high enough that an unmasked individual 200 yards (three city blocks in Portland) from detonation has a maximum of 24 minutes of safety before acute symptoms appear and an individual 1,000 yards away has only 2.5 hours (Cullumbine 1957). It is unclear how $ZnCl_2$ dissipates through a densely-gassed, tree-lined urban landscape within a river valley like Portland, but reported signs and symptoms indicate that it spread widely and cut through protective equipment (Appendix 1). Given its bioaccumulation and the delayed severe inflammation response, $ZnCl_2$ exposure is measured cumulatively over 10 days (Cullumbine 1957). As a highly mobile and poisonous gas, $ZnCl_2$ poses a significant risk to humans as well as the environment. A community of protesters, activists, journalists, legal observers, and

scientists standing up for Black lives documented its use and are just beginning to understand its impacts on the residents and environment of Portland. Human health and environmental impact studies are urgently needed.

All data, code, and supporting materials are included within the supporting information.

Acknowledgements

This work would not have been necessary without law enforcement's desire to poison a city to show how much they believe that Black lives don't matter, and would not have been possible without civilians standing up despite the wanton use of chemical weapons to say that Black lives DO matter. Contributions to the dossier are acknowledged in Appendices 1 and 2. Substantial thank yous to the Don't Shoot Portland team for documenting and organizing around use of chemical weapons in Portland, Sarah Riddle for critical life-cycle documentation, The Recompiler Magazine for aggregation of protest news, and Eric Greatwood for particularly useful footage. Black Lives Matter. Land Back.

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Figure Legends

Figure 1. Time series of Hexachloroethane use (left axis, boxes with vertical lines) compared to normalized (so maximum value is 100) values of the amount of time federal agents were out of their buildings (orange circles and line); the estimated crowd size (salmon circles and line); and Google search trends data for the Portland Metro Area: "protests", "Black Lives Matter", and "federal" (progressively darker purple circles and lines, respectively) in Portland Oregon during July 2020. Hexachloroethane use shows the minimum number known for each day at the box and the line indicates the range of possible values to the upper 95% Credible Interval. See Appendix 2 for full methods details.

Figure 2. Hexachloroethane / Zinc Oxide canisters (top) and reactions (bottom). (a) Unexploded ordnance clearly marked as "Military Style Maximum Smoke HC" from "Defense Technology. (b) HC ordnance off gassing Zinc Chloride mid deployment. (c) Same canister from (b) after reaction stopped, showing charred remains of the label that matches the canister in (a). (d) Three exploded HC canisters, including the one from (b) and (c) in the middle. Photos (a) and

(c) from the author, (b) and (d) from an anonymous collector and used with permission. Reactions and products are taken from Dainton and Ivin (1947), Archer (1979), Eaton et al. (1994), and Shaw et al. (2016).

Figures

Figure 1.

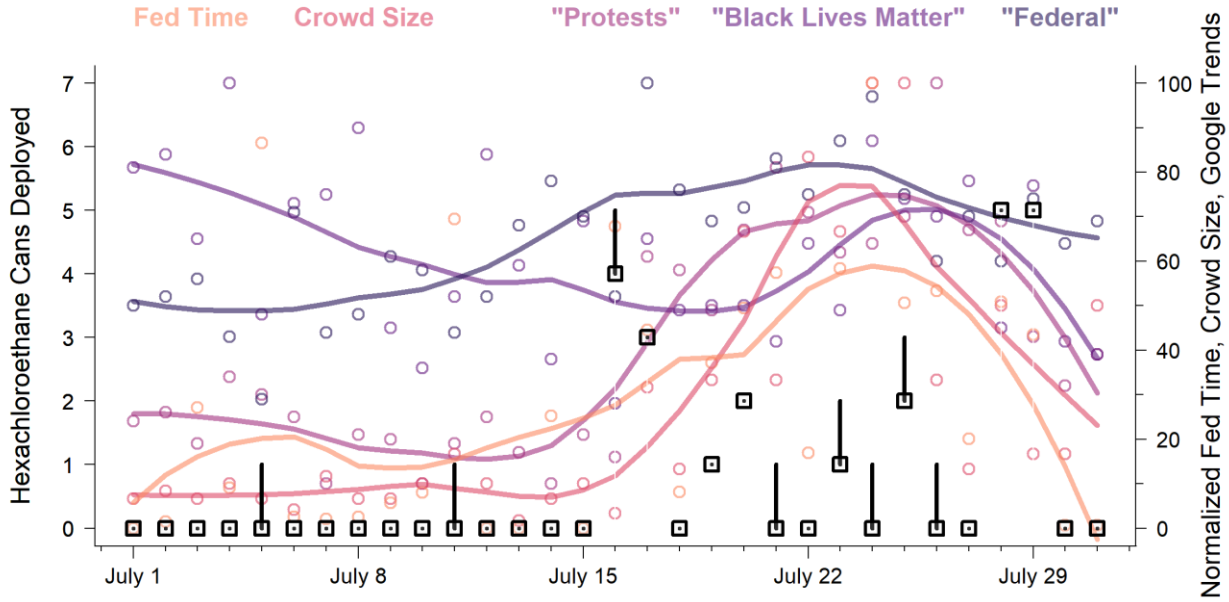

Figure 2.

Ideal Hexachloroethane & Zinc Oxide Reactions

$$C_2Cl_6 + 3ZnO + 2Al \rightarrow 3ZnCl_2 + Al_2O_3 + C$$

$$5C_2Cl_6 + 15ZnO + 6Al \rightarrow 15ZnCl_2 + 3Al_2O_3 + 4C + 6CO$$

Chain Reaction Cracking of Hexachloroethane

$$C_2Cl_6 \rightarrow C_2Cl_4 + Cl_2$$

$$C_2Cl_4 + Cl_2 \rightarrow 2CCl_4$$

Measured Products of Realized Reactions

Zinc Chloride	$ZnCl_2$ (g,l)	Phosgene	$COCl_2$ (g)
Aluminum Oxide	Al_2O_3 (s)	Carbon Tetrachloride	CCl_4 (g)
Carbon	C (s)	Tetrachloroethylene	C_2Cl_4 (g)
Carbon Monoxide	CO (g)	Hexachloroethane	C_2Cl_6 (g,l)
Hydrogen Chloride	HCl (g)	Hexachlorobenzene	C_6Cl_6 (g)