Legislative Testimony – Dr. Peter Barr Gillespie
Joint Committee on Transparent Policing and Use of Force Reform
July 10, 2020

Topic: The Impact of Militarized Policing on the Public: Weapons and Munitions

Chair Manning, Chair Bynum and members of the committee,

My name is Peter Barr-Gillespie PhD, and I am the Chief Research Officer and Executive Vice President at OHSU. Although a good portion of my time is spent leading OHSU's research and innovation mission, I also maintain an active research program that focuses on understanding the molecular mechanisms that enable our sense of hearing. In addition, I direct an international consortium of scientists and researchers whose goal is to develop a therapy for hearing loss that arises after damage from noise, certain prescription drugs, or aging.

I appreciate the opportunity to share my scientific perspective about the hazards of acoustic devices, tear gas and other crowd control techniques used by law enforcement. I am not an expert in policing, but I am an expert in hearing and hearing loss, and have spent time understanding the impact that CS gas and other crowd control techniques can have on the human body.

I would like to begin by discussing the munitions and devices used by law enforcement that employ sound as an instrument of force.

- I'm referring specifically to two types of devices, rubber ball blast grenades and Long Range Acoustic Devices (LRADs) or acoustic cannons.
- If a person is too close to the source, the sound generated by these devices is so loud that it can damage the sensory structures within a person's ears, causing significant hearing loss.
- Some models of rubber ball blast grenades generate a sound blast of 175 dB SPL at a radius of 5 ft, which is extremely damaging to hearing if you are that close. In fact, the rubber ball blast grenade devices used by law enforcement, often called flash-bangs, are actually louder than military-style flash bangs.
- Both acoustic munitions and LRADs can produce sounds ten times louder than a jet aircraft taking off, levels that can rupture the eardrum. Since the eardrum can heal, manufacturers claim that use of these devices would produce only temporary hearing loss.
- I find this minimization of a ruptured eardrum troubling. Damage to the eardrum is only one effect, just the most easily detected. What I worry about most is damage to the sensory cells that detect sound in the ear; such damage is irreversible, as these cells do no regenerate or repair themselves after extensive damage.
- In addition, damage to other parts of the auditory system can cause lasting effects like tinnitus (ringing in the ears).
- Hearing damage caused by these crowd control devices is potentially life-altering to individuals, and using them seems to be an irresponsible risk.

Another technique for crowd control is the distribution of tear gas. While different definitions of "tear gas" exist, I refer here to the use of CS, CN, and OC agents, which are the most commonly used. Tear gas is used because of its ability to incapacitate people by activating pain systems within the human body. But tear gas exposure also has significant effects on vision, breathing, and the skin.

- Within seconds, people exposed to tear gas report (1) burning pain, (2) irritation, and (3) inflammation. The most profound effects are on the eyes, respiratory tract, and skin. Other symptoms include coughing, shortness of breath, chest pain, headache, dizziness, and syncope. Of concern, these effects can linger for hours.
- When exposed to significantly higher levels of tear gas, people can have more severe symptoms, including death—albeit rarely.
- After the acute, disabling effects subside, tear gas can also cause lasting lung and eye damage.

- One of the hazards of tear gas is that once it is deployed, there is no control over where it wafts. Bystanders, including people in cars or even in their homes, can be exposed very easily, and has happened repeatedly at the Portland protests.
- Looking over the literature, I note that there are remarkably few well controlled studies examining the hazards of using tear gas on people. Importantly, even those studies are inadequate, as they were typically done under well controlled conditions that are not matched by tear gas use against protestors. For example, the concentration of the tear gas aerosol can be much higher than expected for a given person if several cannisters deploy near to them.
- Thus police use these hazardous chemicals even though there is limited understanding of their short-, medium-, and long-term effects on humans.
- While not yet proven, it is a reasonable hypothesis to suggest that the use of tear gas will increase transmission of COVID-19. If incapacitated by tear gas, people are more likely to engage in coughing, vomiting, or sneezing, all of which increase transmission to those around them.
- Moreover, COVID-19 transmission occurs through the respiratory system, and irritation caused by tear gas may well increase the chance that the SARS-CoV-2 virus enters cells in the respiratory epithelium.
- Finally, it's not just the tear gas itself. Many injuries have occurred in Portland or elsewhere from the tear gas cannisters themselves hitting protestors or bystanders, often in the back or the back of the head. In other states and countries, protestors have been killed because of head injuries from tear gas cannister deployment. While tear gas is deployed carefully in some cases, in other cases cannisters are launched into crowds without consideration of the protestors' or bystanders' safety.
- Finally, it is worth noting that tear gas use is prohibited in warfare, presumably because of the potential for subsequent escalation to more dangerous gaseous weapons like nerve gases. It is remarkable that our police forces continue to use weaponry that countries agree should not be used on the battlefield.

I would like to make my own comments on where we are as a society at this moment in time and why we are even having this conversation.

- We are squarely in the middle of the first wave—of what could be many waves—of a global coronavirus pandemic that has targeted people and communities of color due to social determinants of health.
- I believe now that these disease disparities between whites and communities of color can be attributed to institutional racism in our society, which has plagued this country for centuries.
- Moreover we are in the middle of an economic crisis that disproportionately impacts those very same people of color.
- It is clear why people are angry. As a society, we have reached a tipping point, and the continued, systemic mistreatment of people of color by law enforcement can no longer be ignored.
- We are centuries too late, but I am heartened that white people have finally joined Black and other people of color in protesting against police violence.

I will end by offering a note of personal concern. I also come to you today as a father who has watched as my son participates in protests against police violence. I'm proud of him and his developing commitment to social justice, but I also worry about his safety.

- To learn what is going on at the protests, I have talked at length with my son, as well as with several OHSU students who have participated in the protests or who attend the protests to offer medical support.
- I understand the extraordinarily difficult position the police are in, as some protestors are interested in property destruction as means of expressing opposition to police violence.
- Nevertheless, many of the protestors, even those at the Justice Center and police precinct building, are not interested in violence but instead are passionate about ending police violence against people of color.
- When people rise up to protest racism and brutality, and are met with continued violence there is no mistaking why protestors continue to march and confront law enforcement.

- Unfortunately, law enforcement agencies are reinforcing the protestors' perceptions of them as being willing to use brutal and indiscriminate techniques that affect not just violent protestors, but peaceful protestors and even bystanders caught up in the action. The violent response of law enforcement triggers a more hostile approach from the protestors, leading to a vicious cycle.
- I urge the committee and law enforcement agencies to consider science-based, proven alternatives for managing large crowds that do not require the use of harmful devices. I'm certain you will learn about many alternative methods throughout the discussions and testimony of this committee. I am by no means an expert in policing so I cannot evaluate these approaches with expertise, but I am sure that there are many in law enforcement who can.

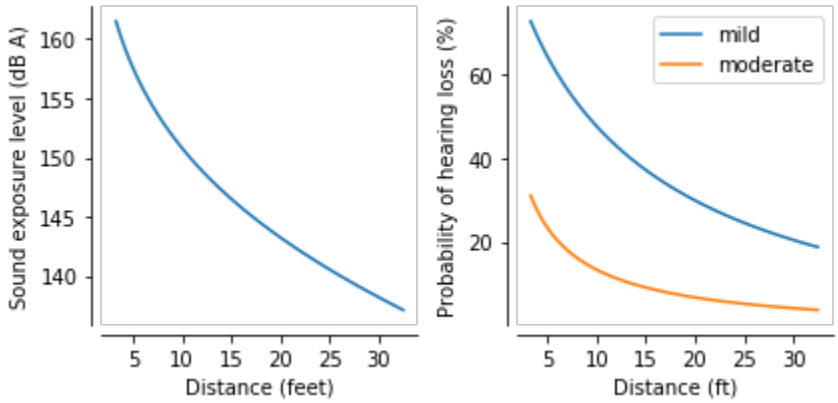
Thank you for the opportunity to speak with you today. I am happy to answer any questions you may have.

APPENDIX: Notes on acoustic munitions

Thanks to Brad Buran, PhD, and Erick Gallun, PhD

- The US Department of Defense has extensive research on the potential damage caused by nonlethal weapons (e.g., acoustic munitions). Using their computational model, we estimated the probability that someone suffers hearing damage from an acoustic munition generating 162 dBA at 5 feet from the blast center.

  The left plot shows the sound level generated by the acoustic munition at various distances from the center of the blast. The right plot shows the probability of suffering mild or moderate hearing loss (moderate hearing loss typically requires hearing aids).



- Assuming the crowd is properly social distancing (i.e., 6 feet between people), there will be 30 people within a 24 foot radius of the acoustic munition. This means that we can expect ~6 people will suffer at least a permanent, mild hearing loss (this does not factor in the increased risk for those near the epicenter).
- There are a large variety of acoustic munitions used in crowd control.
  - The police call these munitions a variety of names including "flash-bangs", "stun grenades", "rubber ball blast grenades", "stinger grenades", etc.
  - Regardless of what they are called, they are designed to produce extremely loud sounds
  - Spec sheet for rubber ball blast grenade reports 175 dB at 5 ft.
    - It's unclear whether this is dBA or dB SPL. If level is reported as dB SPL, then (based on the Friedlander waveform, commonly used to model blast waves), the level is 162 dBA.
    - Per conversation with a military researcher, numbers in the spec sheet are most likely reported in dB SPL.

        - The ear canal amplifies sound[1], possibly contributing to underestimation of acoustic munition sound level.
    - Multiple crowd control munitions are likely deployed and can have a cumulative effect.
    - Based on National Institute for Occupational Safety and Health (NIOSH)[2]:
        - NIOSH regulates the maximum safe exposure limit to protect workers from hearing loss resulting from occupational noise exposure.
        - The maximum "safe" exposure limit depends on the sound level and duration. Using the equation published by NIOSH, the maximum "safe" duration for being exposed to 162 dBA is 0.5 milliseconds. The duration of a blast wave is much longer than this.
    - NIOSH standard are designed for continuous noise and do not translate well to impulse noise (such as that generated by acoustic munitions)
- We are beginning to understand the implications of blast injury for hearing. Blast studies in rodents[3] [4] have demonstrated that a single blast exposure may cause:
    - Permanent loss of sensory hair cells, (cause of permanent hearing loss)
    - Damage to the eardrum and middle ear bones,
    - Loss of neuronal connections to hair cells (thought to be a cause of "hidden hearing loss"),
    - Swelling of the blood vessel layers near the sensory tissue,
    - Increases in fluid pressure inside the cochlea (endolymphatic hydrops).
- While hair cell loss is not thought to be widespread/severe in blast injury, this underestimates the damage caused to hearing, and the ensuing burden placed upon the afflicted individual. This is because the criteria for safe exposure limits is based on a conventional understanding of hearing loss (i.e., we monitor for changes in audiograms). This criteria likely does not protect against hidden hearing loss (i.e., cochlear synaptopathy). This is a recently-discovered form of hearing loss that currently has no diagnostic test available. Hidden hearing loss is thought to result in:
    - Chronic tinnitus (ringing in the ear, ranging from annoying to debilitating)
    - Difficulty communicating in noisy environments (think about your older relatives, military veterans, and friends who have trouble talking in a restaurant or bar)
    - Intolerance to loud sounds (ever had an older relative who complains that they can't hear you, then asks you to stop shouting when you talk louder?)

[1] Shaw EA. The external ear. InAuditory system 1974 (pp. 455-490). Springer, Berlin, Heidelberg.

[2] https://www.cdc.gov/niosh/docs/98-126/default.html

[3] Kim J, Xia A, Grillet N, Applegate BE, Oghalai JS. Osmotic stabilization prevents cochlear synaptopathy after blast trauma. Proceedings of the National Academy of Sciences. 2018 May 22;115(21):E4853-60.

[4] Hickman TT, Smalt C, Bobrow J, Quatieri T, Liberman MC. Blast-induced cochlear synaptopathy in chinchillas. Scientific reports. 2018 Jul 16;8(1):1-2.