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Firearm-related deaths have peaked during the COVID-19 pandemic, surpassing 48,000 cases in 2021 alone. Dr. Eric Fleegler, a pediatric emergency physician at Boston Children's Hospital, states, "During the Covid pandemic, we've seen over a 25% increase in fatalities in the last two years. That has never happened." The recent surge of firearm violence has heavily impacted emergency departments, which have seen a 34% increase in firearm injuries in 2020 compared to the previous year. A significant challenge in managing the growing number of gunshot victims is the immediacy of intervention required, with some sustaining fatal blood loss in as little as 5 minutes. The ability to save a gunshot victim's life is contingent on how fast they receive treatment and as Dr. John M. Porter, director of trauma surgery at Cooper Health, states, "Every minute you bleed, your chances of dying go up." An obstacle to providing the fastest intervention for gunshot victims is that first responders are often limited by how soon a firearm incident is reported. Currently, the average EMS response time falls between 7-10 minutes.

Now, envision the ability to detect and report the precise location of a gunshot, even before a 911 call is placed - this is the power of acoustic gunshot detection systems (AGDS). AGDS, such as the ShotSpotter system, incorporates acoustic sensors to triangulate a gunshot, allowing responders to receive real-time alerts, thus facilitating rapid response times and saving lives. Despite its potential, there is growing controversy regarding the placement of acoustic monitoring devices in socioeconomically vulnerable communities.

The predominant challenge with reporting firearm incidents is the uncertainty surrounding where the gunshots originated. Sound obstruction promotes hesitancy for some residents to call 911 and may indicate why only 52.4% of violent crimes in 2019 involving a weapon were reported to the police. Buildings, cars, trees, and wind, among other obstacles, obstruct sound localization, thus delaying emergency responders. However, AGDS can distinguish between similar noises, such as firecrackers and gunshots, and pinpoint where the incident occurred. From the quick response to gunshots, EMS can access potentially injured victims, triage, and prevent critical blood loss.

AGDS works by placing multiple acoustic microphone sensors on local landmarks such as government buildings and lampposts, which calculate the relative time for sound waves to reach each sensor. If at least three sensors detect a sound wave pulse, the information is packaged and filtered through an artificial intelligence machine-learning algorithm and reviewed by acoustic experts before alerting emergency responders. This process dramatically shortens the time it takes for responders to reach the victim, and the ShotSpotter company claims the time from a gunshot to an alert on their responder app is under 60 seconds.

Healthcare professionals at Cooper Health, located in Camden, New Jersey, previously known as one of America's most violent cities, have recognized the life-saving potential of installing AGDS. Camden implemented ShotSpotter with a Scoop and Run method, where responding officers transported gunshot victims in their vehicle to the trauma center in 2013. The Scoop and Run method allows responding officers to contact nearby hospital providers directly so the trauma team is prepared when the patient arrives, further reducing the time to intervention. Camden has seen its lowest homicide rates since 1988, possibly due to these implementations. A 2019 Cooper Health study examined 627 firearm cases and demonstrated that the Shotspotter

system significantly reduced emergency services' response and transport time. However, no difference was found between adjusted mortality rates between ShotSpotter-activated and Non-ShotSpotter cases. Additionally, this study highlighted that AGDS detected only 37% (190 of 627) of the analyzed shootings, contrasting the company's internal results.

Despite this technology's potential for improving EMS response times, there are controversies regarding accuracy and racial inequities. Forbes estimates AGDS to cost cities $65,000-90,000 per square mile per year, which has caused some cities to abandon this technology in preference of hiring more police officers. The high-crime locations where Shotspotter systems are targeted for installation are uncoincidentally located in financially disadvantaged areas composed predominantly of racial minorities. Aside from the costs that may strain local governments, this technology has heavy implications for privacy violations and further racially disparate policing. Although the ShotSpotter company makes claims against their microphone sensor's ability to pick up conversations, and their marketing campaigns ensure that their product is designed to be equitable, many remain skeptical. Even if the company's claims hold, the biased distribution of these auditory surveillance sets a precedent for the next generation of monitoring technology to propagate the racial divide and profiling.

Numerous recent findings and complaints have caused multiple cities to forego their contract renewal with the company. While ShotSpotter's internal results claim almost impeccable statistics at 97% accuracy and 0.5% false positive rate, many cities with this technology in place have reported far lower accuracy. Reports from Chicago have found that in 50,000 probable gunshot alerts, a mere 9.1% of cases produced evidence of a gunshot-related offense. In this same report, a complaint reads, "[Chicago Police Department] officers, chasing down unfounded ShotSpotter alerts, have stopped and detained thousands of innocent Chicagoans who

happened to be near the location of an alert. CPD officers have used ShotSpotter's presence on the South and West sides of the City as justification for aggressive police tactics — treating residents as suspects, detaining them, and frisking them just because there has supposedly been a history of ShotSpotter alerts in the area." In 2021, a year where firearm mortality was at its highest, ShotSpotter lost $4.4 million.

Considering the many controversies and contrasting reports about ShotSpotter, it becomes difficult to claim that AGDS is suitable for national expansion in its current state. What is uncontroversial is the revolutionary capabilities that the technology brings. Through using acoustic sensors, the system has the potential to save thousands of lives each year. While it will take a multidisciplinary approach, including external validation studies, equitable distribution, and overall improvements to cost structure, AGDS may become a mainstream tool for responders. For the future of healthcare and emergency medicine, it will be interesting to see what role AGDS will play in improving patient outcomes and survivability.