

METRO NASHVILLE COMMUNITY OVERSIGHT

FOR BOARD REVIEW: Informational Report

Regarding ShotSpotter Technology

Presented to the Community Oversight Board

At Its Board Meeting on March 23, 2022

ShotSpotter Informational Report

ShotSpotter in Nashville

It recently came to the attention of MNCO staff that in its FY2021-22 through FY2026-27 Capital Improvement Budget¹, the Metro Nashville Police Department included a line item for ShotSpotter technology. The technology has been budgeted for \$370,000 in FY23 and \$430,000 in FY24, for a total of \$800,000:

22PD0009	ShotSpotter - Gun Shot Detection and Alerting System	Funding (thousands)	FY22	FY23	FY24	FY25	FY26	FY27	Beyond	Total
C Proposed G.O. Bonds			\$370	\$430						\$800

This is not the first time Nashville has considered ShotSpotter. In 2018, City Council went so far as to allocate money to the program for a one-year pilot, but ShotSpotter required² a two or three-year contract and the city couldn't agree to terms on that deal. The pilot was to be implemented in the Cayce, Napier, and Buena Vista Heights/Elizabeth Park neighborhoods.

Especially following the recent release of a WPLN article³ questioning the efficacy of ShotSpotter, public discussion surrounding the technology has intensified among Nashvillians. This report is not intended to provide recommendations about the technology, but rather to answer questions and contribute to the knowledge base regarding the strengths and limitations of the technology.

A Brief Review of the Technology

Since Chief John Drake took office, he has publicly committed to tackling the issue of gun crime, even saying that the Metro Nashville Police Department was dedicating more resources to serious gun crimes "than ever before"⁴. Drake's commitment presents a sizable challenge for a number of reasons, one of which is that only an estimated 20% of shootings are reported to law enforcement⁵. It is challenging to track and reduce gun crimes that are simply not reported to law enforcement. One potential solution to rectify this issue is the use of ShotSpotter.

ShotSpotter is a gun detection technology that utilizes acoustic firearm detection. In practice, this means that ShotSpotter sensors, which have a range of around 1200 feet, are placed in a variety of outdoor settings with the aim of filtering out ambient noise and detecting firearm discharges via triangulation and multilateration across multiple sensors⁶. Via a proprietary algorithm, noises that are suggestive of gunshots are flagged, at which point the ShotSpotter software is activated, and remote "acoustic experts" determine the likelihood that the noise was in fact a firearm and not similar noises like fireworks or a car backfiring. If the expert confirms that it was a firearm, a local law enforcement agency

¹ To read the budget in its entirety, visit: https://www.nashville.gov/sites/default/files/2021-09/FY22_CIB_Adopted.pdf

² <https://www.newschannel5.com/news/nashville-abandons-shotspotter-gunshot-alert-system>

³ <https://wpln.org/post/nashville-police-want-800k-for-a-gunshot-alert-system-but-its-unclear-if-the-technology-is-effective/>

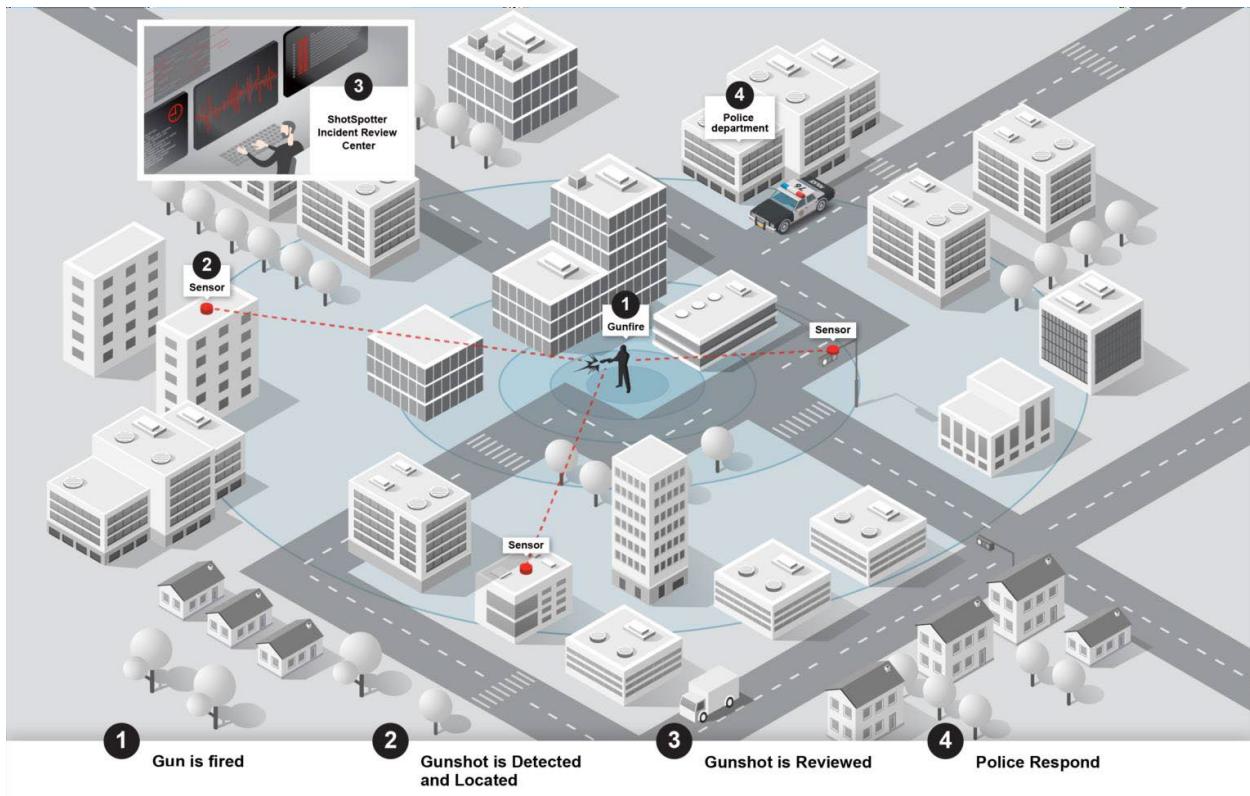
⁴ <https://www.newschannel5.com/news/metro-police-chief-john-drake-mayor-john-cooper-to-discuss-policing-reforms>

⁵ Irvin-Erickson, Yasemin, et al. "The effect of gun violence on local economies." *Washington, DC: Urban Institute* (2016).

⁶ The technical descriptions of triangulation and multilateration are beyond the scope of this paper, but suffice it to say that they are techniques to discern the location of a sound based on the arrival time and angle of sound waves at multiple sensors.

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is contacted. ShotSpotter claims that the entire process, from sound detection through police notification, takes one minute on average⁷. A pictorial⁸ representation of the process is below:



Literature Review

It is easy to see the intuitive appeal of such a technology for law enforcement; within a minute of a potential crime being committed, officers could be on their way to the scene without anyone having to call 911. Some evidence suggests the technology can be highly efficacious: a study from the National Institute of Justice found that 99.6% of 234 firearm discharges across 23 locations were correctly detected by ShotSpotter⁹, and the company itself claims a 97% aggregate accuracy rate¹⁰. It is also widespread: as of December 2020, ShotSpotter itself identified more than 100 cities across the US using its technology, including cities such as Chicago, New York City, Boston, and Denver¹⁰. Such ubiquity and reported accuracy levels make an easy argument for implementation of ShotSpotter.

Research by Doucette and colleagues, however, suggests that

There is currently a lack of robust, peer-reviewed research that examines the impact of [gun detection technology] in general, or ShotSpotter technology specifically, on rates of

⁷ Doucette, Mitchell L., et al. "Impact of ShotSpotter Technology on Firearm Homicides and Arrests Among Large Metropolitan Counties: a Longitudinal Analysis, 1999–2016." *Journal of Urban Health* 98.5 (2021): 609-621.

⁸ ShotSpotter, "Gunshot Detection," <https://www.shotspotter.com/law-enforcement/gunshot-detection/>.

⁹ Litch, M., and G. A. Orrison (2011): "Draft Technical Report for SECURES Demonstration in Hampton and Newport News, Virginia," US DOJ report.

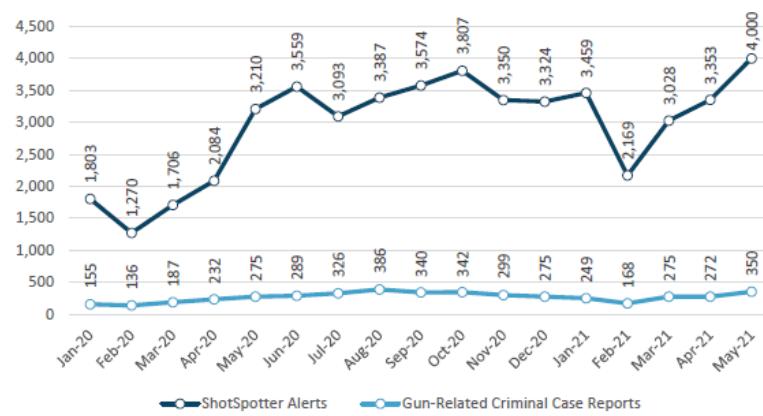
¹⁰ "ShotSpotter Respond FAQ," ShotSpotter, December 2020, <https://www.shotspotter.com/wp-content/uploads/2020/12/ShotSpotter-Respond-FAQ-Dec-2020.pdf>.

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nationwide firearm violence and arrests related to firearm crimes. In fact, such evaluations have been hindered due to the proprietary nature of the data collected by ShotSpotter.

To Doucette's point, there is some peer-reviewed research on ShotSpotter, though not much, and what does exist is largely not in support of the technology. Doucette's research, for example, used publicly available data across 68 large metropolitan counties from 1999 to 2016 to model the impact of ShotSpotter on homicides by firearm, murder arrests, and weapons arrests. They found that implementing ShotSpotter did not have a significant impact on firearm homicides or arrests, finding instead that policy solutions such as permit-to-purchase laws had a more significant impact on such outcomes⁷. Research out of St. Louis showed, on the one hand, a statistically significant, 30% reduction in citizen-initiated calls for service for shots fired following the implementation of their acoustic gunshot detection system; however, there was not any significant reduction in serious violent crime, and in fact there were 1) significantly lower efficiencies in responding to acoustic gunshot detection system calls than citizen-initiated calls for shots fired and 2) accordant increased time demands on officers¹¹. Research from Philadelphia concluded that their acoustic gunshot detection system both increased police workload and did not significantly affect the number of confirmed shootings¹².

An investigation¹³ by the Office of the Inspector General in Chicago provides perhaps the most damning evidence against ShotSpotter. The City of Chicago entered into a three-year, \$33-million-dollar contract with ShotSpotter in August 2018. An analysis of over 50,000 ShotSpotter alerts within that period (which resulted in over 41,000 police responses) revealed that only 9.1% of Chicago Police Department (CPD) responses to ShotSpotter alerts indicated evidence of a gun-related criminal offense. Moreover, there was an investigatory stop in only 2.1% of all CPD responses to ShotSpotter alerts. As can be seen below, even as ShotSpotter alerts trended upward, gun-related criminal case reports did not have any sort of consistent pattern:



Source: OIG analysis.

¹¹ Mares, Dennis, and Emily Blackburn. "Acoustic gunshot detection systems: a quasi-experimental evaluation in St. Louis, MO." *Journal of Experimental Criminology* 17.2 (2021): 193-215.

¹² Ratcliffe, Jerry H., et al. "A partially randomized field experiment on the effect of an acoustic gunshot detection system on police incident reports." *Journal of Experimental Criminology* 15.1 (2019): 67-76.

¹³ Ferguson, Joseph. "The Chicago Police Department's Use of ShotSpotter Technology". Office of Inspector General, City of Chicago. <https://bit.ly/3CLaVpk>

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Said succinctly, most ShotSpotter alerts cannot be connected to any verifiable shooting incident. This is extremely troubling for a technology whose purported aim is to detect gunshots. As the Office of the Inspector General concludes,

[The Chicago Police Department] and [Chicago] would be well-served by being able to clearly demonstrate its law enforcement value. Such a value is not clearly demonstrated by presently available data.

While Chicago continues to use ShotSpotter, it goes against the advice of multiple reports advising against it. A separate report¹⁴ from the MacArthur Justice Center at Northwestern University's Pritzker School of Law found similar results to the Office of the Inspector General in Chicago's report: from July 2019 through April 2021, 89% of ShotSpotter deployments turned up no gun-related crime; 86% led to no report of crime whatsoever; and there were more than 40,000 dead-end deployments.

It is important to note that ShotSpotter has rebuked many of these claims. The company has suggested that criticism against the technology is motivated by a 'defund the police variant', and that ShotSpotter can improve public confidence in police, prevent crime, save lives, and solve shootings. In an op-ed¹⁵ in the Buffalo News, for example, ShotSpotter CEO Ralph Clark claimed that ShotSpotter had alerted police to 101 gunshot wound victims in Oakland in instances where nobody called 911, thus potentially saving their lives. It has pushed back both against the studies and the reporting done on it, going so far as to commission a study critiquing the work done by the MacArthur Justice Center and to file a \$300 million defamation lawsuit against Vice Media¹⁶.

However, when it comes to Nashville, the technology will eat up nearly a million dollars of taxpayer money over the next two years. It is somewhat troubling that this monetary investment is in technology that has murky efficacy at best. There are several cautionary tales of cities who decided against using or continuing to use ShotSpotter: the city of Durham, NC decided that there were enough questions about ShotSpotter's efficacy that they elected not to support a proposed contract with ShotSpotter¹⁷ (though it is back up for debate in council as of writing), while the city of Fall River, MA decided not to renew their contract due to high false alarm rates¹⁸ (of the 51 ShotSpotter activations in Fall River in 2017, 21 of them were false alarms).

Cost

Accordingly, one must consider the issue of cost. As mentioned above, the city has budgeted for \$370,000 in FY23 and \$430,000 in FY24 for ShotSpotter, for a total of \$800,000. ShotSpotter themselves¹⁹ have estimated that the technology costs roughly \$10,000 per square mile in setup costs,

¹⁴ MacArthur Justice Center. ShotSpotter Creates Thousands of Dead-End Police Deployments That Find No Evidence of Actual Gunfire, <https://bit.ly/3hR8FmE>

¹⁵ <https://bit.ly/3tFtJCb>

¹⁶ Jon Schuppe and Joshua Eaton. "How ShotSpotter fights criticism and leverages federal cash to win police contracts". <https://www.nbcnews.com/news/us-news/shotspotter-police-gunshot-technology-federal-grants-rcna13815>

¹⁷ Action Center on Race and the Economy. "21st Century Policing: The RISE and REACH of Surveillance Technology".

¹⁸ <https://www.heraldnews.com/story/news/2017/07/27/false-alarms-lead-fall/20067325007/>

¹⁹ ShotSpotter. ShotSpotter frequently asked questions. Published January 2018. https://www.shotspotter.com/system/content-uploads/SST_FAQ_January_2018.pdf.

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and thereafter somewhere between \$65,000 and \$90,000 per square mile per year. If the midpoint of that cost range is assumed and the startup cost is included, it will cost roughly \$87,500 per square mile to get ShotSpotter set up in Nashville. Given that the city has budgeted only \$370,000 for the first year, it stands to reason that the city will be able to cover somewhere around 4.23 square miles in its first year. This is less than 1% of Nashville's size of 526 square miles.

ShotSpotter both proudly touts the number of cities that have expanded their coverage and warns against several conditions that led to suboptimal deployment of the technology. One of these conditions leading to suboptimal deployment is “too small a deployment area to effectively drive the procedural change management necessary to have a meaningful impact”. While they don’t list the cities who had this particular problem, it is easy to imagine that a coverage zone of less than one percent of a city’s total size would fall under that category. It thus concerns MNCO research staff that one of two things will happen: 1) the program will peter out after just two years with little to show for it, leaving taxpayers to foot the bill, or 2) the small coverage zone will be used as justification for the expansion of a technology which has dubious efficacy.

Conclusion

There is great excitement in the policing community regarding ShotSpotter, but there is also some significant trepidation surrounding the technology. It is a fair characterization to say that evidence surrounding the technology is mixed at best, and that the majority of evidence in favor of ShotSpotter comes from the company itself. In fact, ShotSpotter denied a request from IPVM, an independent security technology research group, to carry out independent tests of its methodology. Further calling data quality into question, the proprietary nature of ShotSpotter’s models, data, and methodology have such a low level of independent evaluation that the ACLU said ShotSpotter “simply isn’t acceptable for data that is used in court”²⁰.

As previously mentioned, roughly nine out of ten times an officer responds to a ShotSpotter dispatch, they find no evidence of a gun-related crime, a statistic that ShotSpotter’s commissioned report finds “meaningless”²¹. This statistic takes on new weight when one considers that Chicago, to take one example, has deployed ShotSpotter in 12 of its 22 police districts; these 12 districts are the ones with the highest proportion of Black and Latinx residents in the city¹⁴. ShotSpotter has responded to this claim by saying it simply is deployed “in the Chicago police districts where violent crime is disproportionately greater”²¹. Without rebutting the factual accuracy of that claim, such deployment has myriad consequences for law-abiding citizens who just so happen to live in these neighborhoods.

Putting these statistics together, nearly nine out of ten times an officer is called to a ShotSpotter dispatch (usually to a non-white neighborhood), there is no evidence of a gun-related crime. This still serves to saturate the neighborhood (again, likely a non-white neighborhood) with police presence to an area that likely has a strained relationship with police at best. In addition, in responding to these calls, it skews the gunshot rates in that neighborhood higher, as the Chicago police require¹⁴ managers to incorporate ShotSpotter data into CompStat reports. This

²⁰ Jay Stanley. “Four Problems with the ShotSpotter Gunshot Detection System”. ACLU News.

<https://www.aclu.org/news/privacy-technology/four-problems-with-the-shotspotter-gunshot-detection-system/>

²¹ <https://ipvm.com/reports/macarthur-edgeworth?code=jsly>

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data then feeds into Chicago's predictive policing software (also owned by ShotSpotter) to help dictate where police are dispatched, thus creating a vicious cycle of overpolicing in neighborhoods that have historically been overpoliced.

With this, MNCO staff conclude that they are unconvinced regarding the efficacy of ShotSpotter's gun detection technology, and dubious regarding the potential negative impacts of the technology, which will likely be disproportionately borne by communities who already suffer the effects of unequal impacts of policing, such as communities of color and communities of low socioeconomic status.