A Bayesian assessment of the impact of a gun violence reduction initiative in Hollenbeck

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Abstract

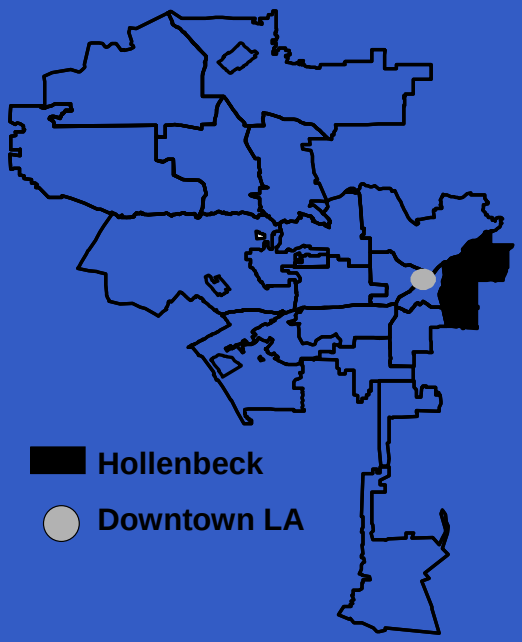
On the eastern edge of the city of Los Angeles lies the Hollenbeck area, a 15 square mile area home to 200,000 of the city's residents as well as two of the areas most violent gangs, The Mob Crew (TMC) and Cuatro Flats. In October of 2000 a brazen "walk-by" shooting occurred in the heart of TMC territory. Five Cuatro Flats members exited a van driven by a female associate, ran around the nearby corner, and opened fire on a group of TMC members in front of a known TMC member's home. After the shooting, two people were dead, a 19 year-old TMC member in the direct line of fire and a 10-year-old child who had been riding her scooter down the street and was killed by a stray bullet. This became the triggering event for Operation Ceasefire, which was launched the next day in the areas of Hollenbeck where TMC and Cuatro Flats were most active. Operation Ceasefire was an intervention based on a model of "collective accountability," one seeking to hold all members of a gang accountable for the act of any individual member. Primary points of leverage were more stringent enforcement of parole and probation conditions and serving of outstanding warrants on gang members who had committed prior offenses, increased LAPD patrols in the territory of the offending gang, more-stringent enforcement of public housing residency requirements for properties used by gang members, and referral of gun law violations to federal prosecutors.

We developed a Bayesian time series model to estimate the causal effect of the intervention on the number of violent crimes. We matched the targeted area of Hollenbeck with other areas with similar levels of crime and demographics. We modeled the number of violent crimes in the intervention and matched sites as Poisson counts with log(crime rates) that follow an AR(1) process. The rates in the intervention and matched sites are assumed to be proportional during the pre-intervention period and then disengaged during the suppression and deterrence phases. Assuming the areas are well matched, the divergence in the time series offer estimates of the causal effect of the intervention.

Our analysis showed that, given the observed trends in violent crimes, the probability that the targeted area's violent crime rate was smaller during the suppression period than what it would have been without the intervention is 95% and the probability of a deterrence effect after the intervention ended is 92%.

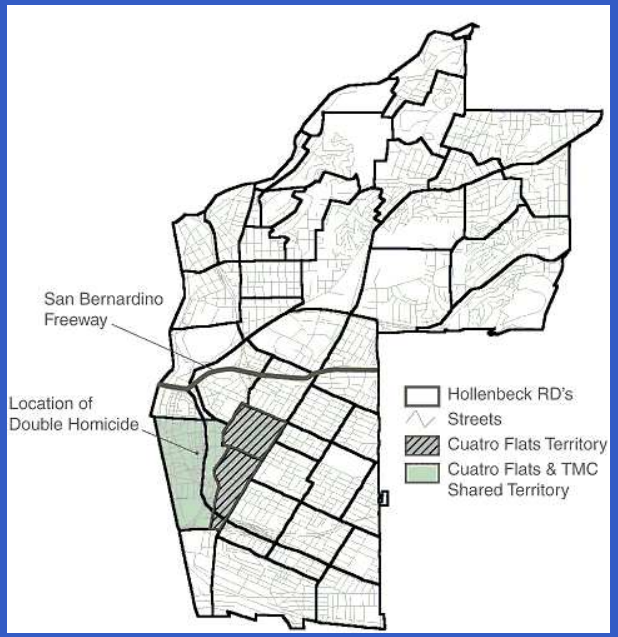
Hollenbeck

Hollenbeck lies at the eastern edge of the Los Angeles city limits and is home to 200,000 of the city's residents, 81% of which are Latino. It is also home to some of the city's oldest gangs, among the most violent are The Mob Crew (TMC) and Cuatro Flats.



Operation Ceasefire

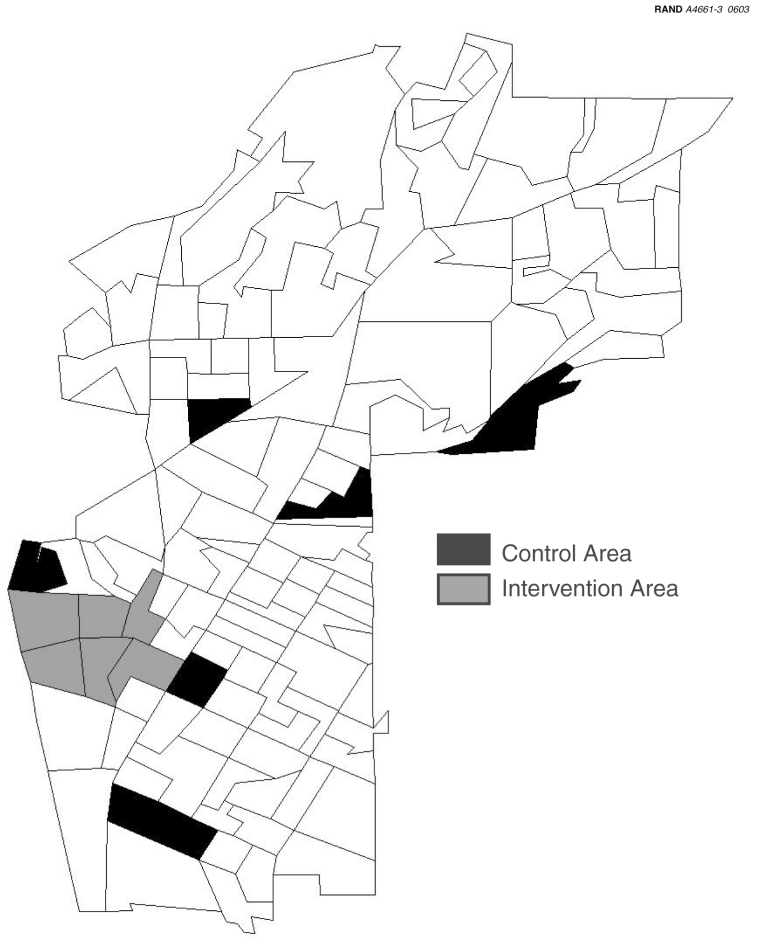
- October 2000, Cuatro Flats kills a 19 year-old TMC member and a 10 year-old child
- Operation Ceasefire was a “collective accountability” based intervention, all members of a gang accountable for the act of any individual member
- Stringent enforcement of parole and probation, serving of outstanding warrants, increased LAPD patrols, stringent enforcement of public housing codes, and federal prosecution.



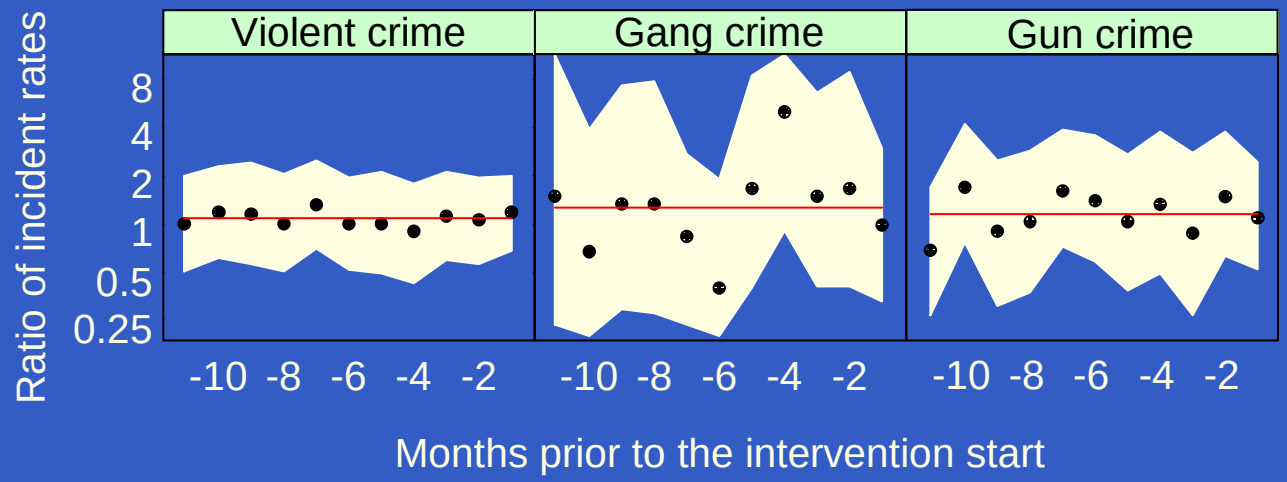
Matching blockgroups

Propensity score matched six non-targeted blockgroups on

- income,
- poverty,
- households that rent,
- population density, and
- population mobility



Proportional crime rate assumption



- In the absence of an intervention, the violent crime rate in the intervention areas will be proportional to the violent crime rate in the control areas over the study's time span
- The proportionality reflects differences in geographic size and exposure to law enforcement
- The preintervention data support the proportional rates assumption

Violent incidents data

		Number of events		Incident rate	
	Month	control	treatment	control	treatment
Pre-intervention	1	12	26	λ_1	$k_1\lambda_1$
	2	11	19	λ_2	$k_1\lambda_2$
	3	12	27	λ_3	$k_1\lambda_3$
	4	16	30	λ_4	$k_1\lambda_4$
	5	13	36	λ_5	$k_1\lambda_5$
	6	15	29	λ_6	$k_1\lambda_6$
Suppression	7	8	10	λ_7	$k_2\lambda_7$
	8	10	10	λ_8	$k_2\lambda_8$
	9	6	12	λ_9	$k_2\lambda_9$
	10	9	31	λ_{10}	$k_2\lambda_{10}$
Deterrence	11	9	21	λ_{11}	$k_3\lambda_{11}$
	12	15	18	λ_{12}	$k_3\lambda_{12}$

The model

- Incidents in the control area are Poisson
  $X_t \sim \text{Poisson}(\lambda_t)$
- Incidents in the intervention area are Poisson
  $Y_t \sim \text{Poisson}(k_{j(t)}\lambda_t)$
- The log violent crime rate is an AR(1) process
  $\log \lambda_t = \mu + \epsilon_t,\ \epsilon_t \sim N(\theta\epsilon_{t-1}, \tau^2)$
- Primary interest is the percent reduction in the incident rate relative to what we would have expected in the absence of the intervention
  - Suppression effect (k_2/k_1)
  - Deterrence effect (k_3/k_1)

Results: all violent crimes

	Posterior		
Parameter	mean	SD	95% interval
k_1	2.35	0.31	(1.80, 3.01)
k_2	1.59	0.31	(1.08, 2.29)
k_3	1.70	0.38	(1.07, 2.54)
k_2/k_1	0.69	0.16	(0.44, 1.08)
k_3/k_1	0.73	0.18	(0.44, 1.15)

P(suppression effect) = 95.5%

P(deterrence effect) = 92.2%

Results: gang crimes

	Posterior		
Parameter	mean	SD	95% interval
k_1	0.83	0.22	(0.48, 1.34)
k_2	0.51	0.18	(0.23, 0.92)
k_3	1.35	0.44	(0.65, 2.38)
k_2/k_1	0.65	0.27	(0.26, 1.31)
k_3/k_1	1.71	0.66	(0.71, 3.29)

P(suppression effect) = 89.7%

P(deterrence effect) = 11.0%

Results: gun crimes

	Posterior		
Parameter	mean	SD	95% interval
k_1	0.31	0.06	(0.21, 0.44)
k_2	0.22	0.08	(0.10, 0.42)
k_3	0.63	0.20	(0.32, 1.13)
k_2/k_1	0.73	0.31	(0.30, 1.48)
k_3/k_1	2.10	0.80	(0.92, 4.03)

P(suppression effect) = 83.2%

P(deterrence effect) = 3.8%

Conclusions

- Operation Ceasefire
  - offered a 30% reduction in violent crimes, an effect that continued after the intervention period
  - reduced gang-related crime and crimes involving guns by 35% and 27%, respectively, during the active suppression phase but the effect did not last into the deterrence phase
- Bayesian analysis
  - facilitated modeling the latent rates that connect the intervention and control rates
  - offered direct estimates of the suppression and deterrence effects