

The Life Cycle of Crime Guns: A Description Based on Guns Recovered From Young People in California

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See editorial, p. 743.

Study objective: We describe the life cycle of crime guns recovered from young people—the movement of those guns from manufacture to criminal use—and identify associations between the characteristics of those guns and their possessors, purchasers, sellers, and places of origin.

Methods: This is a cross-sectional study of data from gun ownership tracing records compiled by the Bureau of Alcohol, Tobacco, Firearms and Explosives for 2,121 crime guns recovered in California from persons younger than 25 years and traced in 1999. Purchaser and seller data for handguns were updated when possible by linking to California handgun sales records.

Results: The 2,121 traced guns were recovered from 1,717 young people. Guns recovered from persons aged 21 to 24 years were most frequently also purchased by persons aged 21 to 24 years; those recovered from persons younger than 18 years were most often purchased by persons aged 45 years or older. Small-caliber handguns made up 41.0% of handguns recovered from persons younger than 18 years but 25.2% of handguns recovered from persons aged 21 to 24 years. The median time from sale to recovery (commonly called time to crime) for all guns was 6.4 years (interquartile range 2.7 to 12.4 years). A time to crime of less than 3 years, suggesting deliberate gun trafficking, was observed for 17.3% of guns recovered from persons younger than 18 years but 34.6% of guns recovered from persons aged 21 to 24 years. Ten retailers who sold 10 or more traced guns accounted for 13.1% of all guns traced to a retailer. Handguns whose purchaser and possessor were the same person were more likely than others to be large-caliber semiautomatic pistols (29.3% and 11.7%, respectively); their median time to crime was 0.2 years (69 days).

Conclusion: Analysis of crime-gun ownership traces reveals patterns that may help refine gun violence prevention efforts and render them more effective.

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Editor's Capsule Summary**What is already known on this topic**

There are well-defined high-risk groups for illegal gun possession and use (eg, persons aged 18 to 20 years). The majority of guns used in crimes are not under their original ownership at the time of a crime.

What question this study addressed

Using data for 2,121 guns recovered and traced in California in 1999, this study examines where persons younger than 25 years access guns used in crimes and the life cycle of these guns.

What this study adds to our knowledge

Semi-automatic weapons accounted for more than half of guns used in crimes. A significant minority of crime guns appear to be obtained through trafficking (17% of guns used by juveniles and 35% of guns recovered from 21 to 24 year olds). The median time to crime for all guns studied was 6.4 years.

How this might change clinical practice

Knowing patterns of gun use can guide research and violence prevention efforts, especially for persons younger than 25 years.

data in a manner analogous to public health surveillance⁸⁻¹²; the data are a valuable resource in disrupting illegal gun markets.¹³⁻¹⁵ However, the value of studying guns in relationship to the hosts, vectors, and environments for gun violence is only beginning to be realized.

Importance

Data that will help prevent the movement of guns from manufacture to criminal use are urgently needed. From 2000 to 2001, gun homicides increased by 5%,^{2,16} gun assaults by 0.7%, and gun robberies by 6.5%.^{17,18}

America's young people—those younger than 25 years—remain at particularly high risk for gun violence. In 2000, 39% of those who died in gun homicides were in this age group.¹⁶ That same year, 43% of crime guns recovered by urban law enforcement agencies were taken from young people.¹² In 1999, 54% of high school students said it would be “easy” for them to acquire a gun,¹⁹ and 9% of male students reported that they had carried a gun in the preceding month.²⁰

Goals of This Investigation

Using data for 2,121 guns recovered from young people in California and traced in 1999, we expand on previous analyses of gun-trace data⁸⁻¹² to depict the life cycle of those guns and identify associations between characteristics of the guns and their possessors, purchasers, sellers, and places of origin.

INTRODUCTION**Background**

The advent of terrorism has forced health professionals to become experts on many previously unfamiliar agents of disease and injury. Understanding the life cycles of pathogens such as smallpox and anthrax will be critical to efforts to contain them. Nonliving agents such as explosives may also follow predictable paths, analogous to life cycles, from their production to distribution and criminal use; knowledge of those paths will help prevent such use.

In 1980, Baker et al¹ proposed that firearms, which in 2001 accounted for 11,348 deaths by homicide alone,² likewise proceed by recognizable steps from manufacture to use in violence. Repeated calls³⁻⁵ for a nationwide violent injury surveillance system have led to a National Violent Death Reporting System that will gather state-based data on violent deaths of all types.⁶ However, the National Violent Death Reporting System will gather only limited information on the life cycle of firearms involved in these deaths.

In contrast, detailed information is collected for more than 200,000 crime-involved firearms each year by the federal Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF),⁷ which attempts to trace the ownership of those guns from their manufacture through their first retail sale. Recent ATF reports have aggregated these

METHODS

ATF provided records for all guns traced nationwide in 1999. A gun trace begins with a law enforcement agency request containing identifiers for the gun (ie, manufacturer, serial number, type, caliber); its possessor, if any (ie, name, sex, date of birth, address); recovery date (date of confiscation by law enforcement); recovery location; and the most serious crime linked to the gun. ATF attempts to reconstruct the gun's initial chain of ownership. A completed trace also includes identifiers for the federal firearm licensee who first sold the gun at retail (typically a gun dealer or pawn shop), its first retail purchaser, and the sale date.

The California Department of Justice furnished records of handgun sales for state-licensed gun retailers for 1995 to 1999. (The California Department of Justice is prohibited from retaining sales records for rifles and shotguns.) Each record contained identifiers for the handgun, purchaser, and seller. The study was approved by our institutional review board.

From the ATF records, we identified all guns traced in 1999 that were recovered from possessors younger than 25 years in California or, when recovery location was missing, by a California law enforcement agency or ATF office. We were unable to include all guns recovered in 1999 because records for guns recovered in 1999 but traced in 2000 were unavailable. Guns recovered in 1998 and traced in 1999 were used in their place.

We divided gun possessors by age: younger than 18 years (statutory juveniles, unable to purchase firearms), 18 to 20 years (too young to purchase handguns in California but able to purchase rifles and shotguns), and 21 to 24 years (able to purchase handguns). We tentatively identified multiple listings of individuals by using the first 3 letters of the surname, first initial, and birthdate and verified tentative matches by manual review.

We divided guns into standard classes (ie, handgun, rifle, shotgun, and combination gun [both rifle and shotgun]) and subdivided handguns into types (ie, semiautomatic pistol, revolver, and derringer). By following common usage,²¹⁻²⁴ we classified handgun caliber as small (eg, .22, .25, .32), medium (eg, .38, 9 mm), or large (eg, .357, .40, .45).

We expressed the interval between the sale and recovery dates as time to crime, which is used as a proxy for the interval between a gun's dates of sale and use in crime because trace records do not contain crime dates.⁹⁻¹³ A time to crime of less than 3 years, and especially of less than 1 year, suggests that the gun was acquired to supply the criminal market, a process known as trafficking.⁹⁻¹³ We analyzed time to crime as a continuous variable and as a categorical variable with strata less than 1 year, 1 to 2 years, 3 to 4 years, and 5 years or greater.

Crimes were grouped into 9 categories in ATF's records: assaults/threats, burglary/theft/fraud, firearms offenses, homicide, kidnapping, narcotics, robbery, vice crimes, and other. We aggregated homicides, assaults/threats, robberies, and kidnappings as violent crimes, and we disaggregated the firearm offenses: illegal carrying or firing, illegal possession, and other/unspecified.

ATF gun traces will not identify the most recent seller and purchaser of the nearly 90% of crime guns that are possessed by someone other than their first retail purchaser when recovered by law enforcement.^{11,12} To identify additional sales of handguns that were later recovered and traced, we developed a matching procedure to link traced handguns to their California sales records. A match on manufacturer and serial number

alone was insufficient; some manufacturers have reused serial numbers. We accepted as matches cases in which the manufacturer, serial number, handgun type, and caliber were identical. When type or caliber was discordant, we compared records manually, reviewing model designations and referring to standard firearm catalogs^{25,26} when necessary, to determine whether the discordance was real or caused by an error in the trace or sales record.

When 1 or more sales recorded in the California data occurred after the sale recorded in the ATF trace, or when the ATF trace contained no sales information, we updated our data set to reflect the most recent sale in the California data. When we found no record for a traced handgun in the California data, or when the only record was for the gun's first sale (and this was already included in the ATF trace), no changes were made. We used the updated trace data in our main analyses. Separately, we compared findings from the original ATF traces and the updated traces for handguns for which updates were possible.

We relied primarily on descriptive measures. Continuous variables were summarized as means with SDs or as medians with interquartile ranges (IQRs). Comparisons between proportions were expressed as absolute differences with 95% confidence intervals (CIs). We used SAS software (version 8.0, SAS Institute, Cary, NC) for most analyses; CIs were calculated by using Confidence Interval Analysis software (British Medical Association, London, England).

RESULTS

Of 2,121 guns in the study, 1,776 (83.7%) were recovered in 1999, and 345 (16.3%) were recovered in 1998.

Altogether, 1,717 gun possessors younger than 25 years, of whom 1,622 (95.5%) were male and 1,003 (58.6%) were not of legal age to purchase handguns, were linked to the 2,121 traced guns (Table 1). Of these individuals, 241 (14.0%) possessed more than 1 gun and accounted for 645 guns (30.4%). Possession of more than 1 gun was more prevalent among possessors aged 21 to 24 years (16.7%) than those aged 18 to 20 years (13.2%) or younger than 18 years (10.3%).

A total of 992 gun purchasers were identified (Table 1). Most purchasers (70.3%) were aged 25 years and older; mean (\pm SD) age was 32.6 (\pm 15.1) years. These individuals purchased 1,024 (48.3%) of the guns in the study; no purchaser was identified for 1,097 guns. Twenty-six (2.6%) purchasers bought more than 1

traced gun; they accounted for 58 guns, 5.7% of guns whose purchasers were known.

The age difference between the possessors and purchasers of guns varied with the age of the possessors (Figure 1). Guns recovered from persons aged 21 to 24 years were most frequently purchased by persons of that same age (33.9%); guns recovered from persons aged 18 to 20 years most frequently had purchasers aged 25 to 34 years (32.8%).

The possessors of 50 guns had also purchased those guns. These 50 cases made up 4.9% of guns with an

identified possessor and purchaser and 9.6% of guns for which, in addition, the possessor was at least 21 years of age (able to purchase handguns).

Of all 2,121 guns, 283 (13.3%) were linked to violent crimes (Table 2). Illegal gun possession was the most common offense overall (38.6%) and for each age and sex subgroup (Table 2).

Handguns accounted for 76.4% of the 2,121 guns, with little variation by possessor age or sex (Table 3). More than two thirds of handguns—52.4% of all guns—were semiautomatic pistols. Revolvers were more common among guns recovered from men than women (difference 17.2%; 95% CI 8.8% to 25.6%); the reverse was true of semiautomatic pistols (Table 3).

Half the handguns (49.5%) were medium caliber, but caliber distributions varied with possessor age and sex (Table 3). Small-caliber handguns made up 41.0% of those recovered from persons younger than 18 years but 25.2% of those recovered from persons aged 21 to 24 years (difference 15.8%; 95% CI 9.6% to 22.0%). Caliber also varied with handgun type (Table E1, available at <http://www.mosby.com/AnnEmergMed>); large-caliber guns accounted for 28.6% of revolvers, 15.8% of semiautomatic pistols, and 10.7% of deringers.

The median time to crime for all guns was 6.4 years (IQR 2.7 to 12.4 years). Time to crime varied with the age of gun possessors (Table 3; Figure 2). Time to crime was less than 3 years for 34.6% of guns recovered from persons aged 21 to 24 years but 17.3% of guns recovered

Table 1. Persons linked to 2,121 guns recovered from young people in California and traced in 1999.*

Characteristic	Possessors, No. (%) (N=1,717)	Purchasers, No. (%) (N=992)
Sex		
Male	1,622 (95.5)	854 (86.6)
Female	77 (4.5)	132 (13.4)
Age, y		
<18†	368 (21.5)	—
18–20	635 (37.1)	18 (1.9)
21–24	711 (41.5)	254 (27.4)
25–34	—	270 (29.1)
35–44	—	189 (20.4)
≥ 45	—	196 (21.1)

*Sex is missing for 18 possessors and 6 purchasers. Age is missing for 3 possessors and 65 purchasers. Percentages are of subjects with data available.

†Number of possessors by individual year of age: age 7, 1; age 10, 1; age 11, 1; age 12, 9; age 13, 20; age 14, 27; age 15, 82; age 16, 81; age 17, 146.

Figure 1. Relationship between possessor age and purchaser age for guns recovered from young people in California and traced in 1999. Data are available for 992 guns.

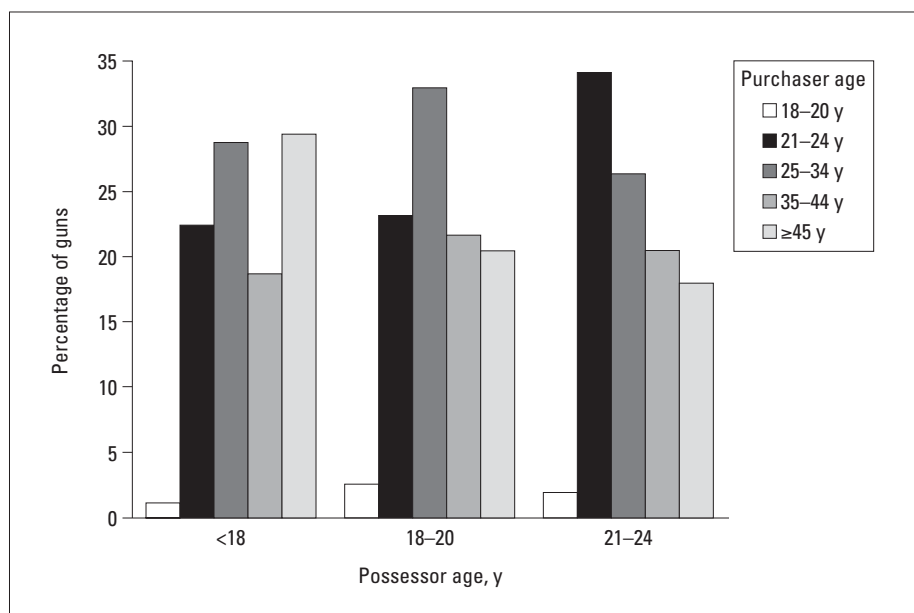


Table 2.

Crimes linked to 2,121 guns recovered from young people in California and traced in 1999, as a function of possessor age and sex.

Characteristic	All Guns (N=2,121)	Possessor Age (N=2,118)			Possessor Sex (N=2,099)	
		<18 y (N=432)	18–20 y (N=764)	21–24 y (N=922)	Male (N=2,007)	Female (N=92)
Violent crimes, %*	13.3	16.4	12.7	12.5	13.0	21.7
Specific crimes, %						
Homicide	3.4	3.5	2.6	4.0	3.4	3.3
Assault/threat	6.1	7.6	5.4	6.0	5.8	12.0
Robbery	3.8	5.3	4.6	2.4	3.7	6.5
Gun carrying, firing	3.3	5.1	3.5	2.3	3.4	2.2
Gun possession	38.6	44.2	38.4	36.3	39.4	27.2
Gun offense, other/unspecified	27.5	20.6	29.1	29.5	27.3	25.0
Narcotics	10.0	3.0	9.2	13.8	9.7	17.4
Burglary/theft/fraud	4.8	7.9	5.2	3.0	4.8	4.4
Other†	2.5	2.8	2.1	2.7	2.5	2.2

*Homicide, assault/threat, robbery, kidnapping.

†Kidnapping, vice crimes, driving while intoxicated, public order offenses, health and safety offenses.

Table 3.

*Characteristics of 2,121 guns recovered from young people in California and traced in 1999, as a function of possessor age and sex.**

Characteristic	All Guns (N=2,121)	Possessor Age (N=2,118)			Possessor Sex (N=2,099)	
		<18 y (N=432)	18–20 y (N=764)	21–24 y (N=922)	Male (N=2,007)	Female (N=92)
Gun class, No. (%)						
Handgun	1,620 (76.4)	337 (78.0)	582 (76.2)	698 (75.7)	1,535 (76.5)	68 (73.9)
Rifle	278 (13.1)	55 (12.7)	107 (14.0)	116 (12.6)	262 (13.1)	12 (13.0)
Shotgun	220 (10.4)	40 (9.3)	72 (9.4)	108 (11.7)	208 (10.4)	12 (13.0)
Combination†	3 (0.1)	0	3 (0.4)	0	2 (0.1)	0
Handgun type, No. (%)*						
Pistol	1,112 (68.6)	219 (65.0)	389 (69.9)	501 (71.8)	1,042 (67.8)	58 (85.3)
Revolver	480 (29.6)	112 (33.2)	183 (31.4)	185 (26.5)	467 (30.4)	9 (13.2)
Derringer	28 (1.7)	6 (1.8)	10 (1.9)	12 (1.7)	26 (1.7)	1 (1.5)
Handgun caliber, No. (%)§						
Small	499 (31.0)	137 (41.0)	185 (32.1)	175 (25.2)	463 (30.4)	29 (42.7)
Medium	796 (49.5)	156 (46.7)	285 (49.4)	354 (51.0)	757 (49.7)	33 (48.5)
Large	313 (19.5)	41 (12.3)	107 (18.5)	165 (23.8)	303 (19.9)	6 (8.8)
Median time to crime, y (IQR)	6.4 (2.7–12.4)	7.7 (4.6–14.7)	7.0 (3.7–13.7)	5.5 (1.8–10.1)	6.4 (2.7–12.4)	6.2 (2.5–12.4)
Time to crime, y, No. (%) 						
<1	122 (12.1)	11 (5.6)	29 (8.5)	82 (17.4)	118 (12.2)	4 (10.5)
1–2	145 (14.4)	23 (11.7)	41 (12.0)	81 (17.2)	136 (14.1)	7 (18.4)
3–4	116 (11.5)	20 (10.2)	40 (11.7)	56 (11.8)	111 (11.5)	4 (10.5)
≥5	627 (62.1)	142 (72.5)	232 (67.8)	252 (53.5)	600 (62.2)	23 (60.5)
In-state origin, No. (%)¶						
Yes	857 (66.4)	167 (66.8)	293 (65.0)	396 (67.5)	814 (66.2)	35 (68.6)
No	433 (33.6)	83 (33.2)	158 (35.0)	191 (32.5)	416 (33.2)	16 (31.4)

*Age is missing for possessors of 3 guns and sex is missing for possessors of 22 guns; percentages are of observations with data available.

†A firearm designed to function as a rifle and a shotgun.

‡Available for 1,620 handguns.

§Available for 1,608 handguns.

||Available for 1,010 guns.

¶Available for 1,290 guns.

from persons younger than 18 years (difference 17.3%; 95% CI 10.4% to 24.1%).

Time to crime also varied substantially with gun characteristics (Table E1; Figure 2). More than one third (33.7%) of semiautomatic pistols but less than 15% of rifles and revolvers had a time to crime of less than 3 years (Table 4).

Six of the 10 most frequently traced guns were semiautomatic pistols (Table E2, available at <http://www.mosby.com/AnnEmergMed>). Smith and Wesson .38 revolvers, ranked first, accounted for 3.5% of all guns and 4.6% of handguns; Norinco 7.62-mm rifles, ranked second, accounted for 21.6% of all rifles; and Mossberg 12-gauge shotguns, ranked fourth, made up 23.6% of shotguns.

Of 58 guns bought by purchasers of more than 1 traced gun, the 48 handguns were more likely than other handguns to be large-caliber semiautomatic pistols (25.0% and 10.3%, respectively; difference 14.7%; 95% CI 2.4% to 27.0%). Twenty-seven (56.3%) of these handguns were bought in purchases of multiple handguns from the same retailer within 5 business days, which retailers must report to ATF. Median time to crime for all 58 guns was 2.2 years (IQR 0.6 to 7.4 years).

Of 50 guns whose possessor and purchaser were the same person, the 41 handguns were again more likely than others to be large-caliber semiautomatic pistols (29.3% and 11.7%, respectively; difference 17.5%; 95% CI 3.4% to 31.7%). Median time to crime for 49 guns with data available was 0.5 years (IQR 0.2 to 0.8 years);

for large-caliber semiautomatic pistols, median time to crime was 69 days, or 0.2 years (IQR 0.1 to 0.8 years).

There were no associations between gun characteristics and crime types (data not shown).

Of 1,290 guns whose retailer locations were known, 857 (66.4%) were sold by an in-state retailer. This proportion varied little with possessor age or sex (Table 3) or gun characteristics (Table E1), but varied widely among individual guns (Table E2). Of 753 guns sold in California with known recovery locations, 473 (62.8%) were sold and recovered in the same county; 165 (21.9%) were sold and recovered in the same city.

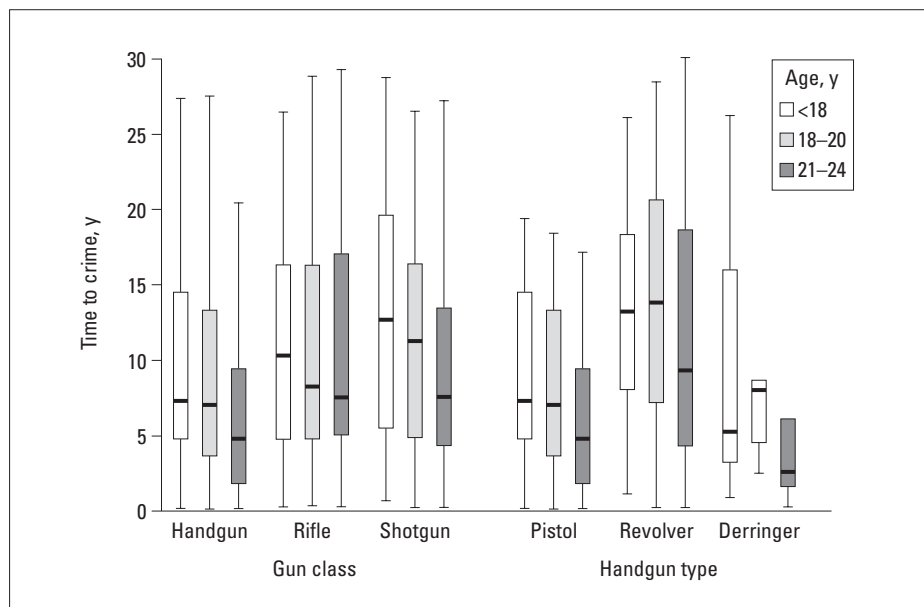
Four states accounted for 35.9% of 433 guns sold by out-of-state retailers: Arizona (13.2%), Texas (9.0%), Florida (7.9%), and Nevada (5.8%). Time to crime was

Table 4. Distribution of licensees and traced guns, by number of guns traced to the licensees, for guns recovered from young people in California and traced in 1999.*

No. of Traced Guns in 1999	Licensees Having That No. of Traced Guns, No. (%)	Traced Guns Linked to Those Licensees, No. (%)
1	651 (80.2)	651 (48.6)
2-4	121 (14.9)	288 (22.3)
5-9	27 (3.3)	168 (12.6)
10-24	12 (1.5)	180 (13.5)
≥25	1 (0.1)	41 (3.1)
Total	812 (100.0)	1,338 (100.1)

*Data are available for 1,338 guns.

Figure 2. Time to crime, by gun type and age, for guns recovered from young people in California and traced in 1999. Data are available for 1,010 guns. The upper and lower adjacent values indicate the most extreme data points that are within 1.5 times the IQR from the ends of the rectangles.⁵⁴



less than 3 years for 30.2% of in-state guns and 19.0% of guns from other states (difference 11.2%; 95% CI 5.4% to 17.1%).

Altogether, 812 firearm licensees were identified as sellers of 1 or more traced guns (Table 4). Ten retailers selling 10 or more traced guns accounted for 13.1% of guns traced to a licensee. Guns from 5 of these 10 retailers had a median time to crime of less than 3 years. A single retailer sold 28.9% of the traced Mossberg 12-gauge shotguns. Three nonretailer licensees were also linked to 10 or more traced guns: 1 law-enforcement agency (21 guns) and 2 gun importers (14 and 11 guns).

Guns were recovered in 152 cities. Six cities that traced all recovered guns—Los Angeles, Stockton, San Diego, Compton, San Bernardino, and San Jose—accounted for 68.4% of traced guns. These guns were more likely than others to be recovered from persons younger than 18 years (23.4% and 13.9%, respectively; difference 9.5%; 95% CI 6.1% to 12.9%) and less likely from persons aged 21 to 24 years (39.6% and 51.9%, respectively; difference 12.3%; 95% CI 7.8% to 16.8%). They were more often handguns (80.0% and 68.6%, respectively; difference 11.4%; 95% CI 7.4% to 15.5%). Guns from these and other cities were otherwise similar (data not shown).

One or more California sales records were identified for 186 (11.5%) of 1,620 traced handguns. In 91 cases, these records provided new information on the gun's seller, purchaser, and time to crime; Table 5 presents selected examples. Sales records provided the only seller information for 41 of these 91 guns and the only time to crime estimate for 61 guns. Cases with an identified purchaser increased from 31 (34%) to 91 (100%); cases in which the gun's purchaser and possessor were identified as the same person increased from 18 (20%) to 32 (35%). For the 30 guns with a time to crime available from the ATF trace, median time to crime was reduced from 5.5 years (IQR 3.0 to 8.4 years) to 1.7 years (IQR 0.7 to 2.6 years).

LIMITATIONS

We included only guns recovered from young people in a single state, and attributes of traced guns vary with demographic characteristics, time, and location.⁹⁻¹² Our guns came disproportionately from 6 cities that traced all recovered crime guns. These cities account for one third of major violent crime in California,²⁷ however, and their guns often resembled those recovered elsewhere.

Table 5. Results of standard and updated traces for selected guns recovered from young people in California and traced in 1999.*

Case	Maker	Model	Caliber	Standard Trace to First Retail Sale						Updated Trace	
				Serial No. [†]	Recovery Date	Recovery City	Retailer Known	Sale Date	Time to Crime, y	Sale Date	Time to Crime, y
1	Glock	23	40	BUXX3US	3/6/99	Los Angeles	Yes	—	—	6/8/96 5/22/98 6/13/98	2.74 0.79 0.73
2	Smith & Wesson	910	9	VDXX53	2/1/99	—	Yes	2/28/96	2.93	2/28/96 9/20/98	2.93 0.37
3	Davis	P380	380	APXX434	9/21/99	Long Beach	Yes	6/3/92	7.3	6/14/95 2/10/96	4.27 3.61
4	Smith & Wesson	SIGMA	9	PAXX33	9/28/99	Fremont	Yes	4/28/95	4.42	3/19/97 6/25/99	2.53 0.26
5	Davis	P32	32	POXX08	9/8/99	Fresno	Yes	10/21/87	11.88	3/6/95 2/10/97	4.51 2.57
6	Glock		40	CXXX3US	12/27/98	Los Angeles	Yes	10/8/98	0.22	11/2/98	0.15
7	Glock	19	9	CXX92US	12/22/98	Santa Ana	Yes	4/21/98	0.67	12/1/98	0.06
8	Smith & Wesson	147	9	EXXX555	11/2/98	Los Angeles	Yes	7/20/98	0.29	9/18/98	0.12
9	Lorcin	L9	9	LXX041	2/3/99	Los Angeles	Yes	—	—	6/7/98	0.66
10	Colt		25	36XX3	2/17/99	San Fernando	No	—	—	12/18/98	0.17
11	Glock	17	9	CXXX3US	1/16/99	Oakland	Yes	—	—	12/3/98	0.12

*Narrative summary of first 2 example cases:

In case 1, a Glock model 23, .40 caliber, semiautomatic pistol was recovered on March 6, 1999, in Los Angeles. The standard trace identified the retailer who first sold the gun, but the date of purchase and, therefore, time to crime were unknown. The sales data identified 3 transactions, the last of which occurred less than a year before the gun's recovery. In case 2, a Smith and Wesson semiautomatic pistol was recovered February 1, 1999. The standard trace and the sales archive recorded a first sale in February 1996, but the sales data identified a subsequent transfer just over 4 months before the gun's recovery.

[†]Serial numbers have been modified.

Tracing data have been criticized as undercounting crime guns, as subject to selection bias, and as including guns not actually involved in violent crime.^{28,29} Our data do undercount crime guns; California Department of Justice data³⁰ suggest that persons younger than 25 years committed approximately 600 homicides, 4,100 robberies, and 5,400 assaults with guns in 1999. Selection bias is reduced here, unfortunately to an unknown degree, precisely because these guns frequently came from cities with comprehensive tracing programs. Most gun recoveries are not incidental to the commission of violent crimes. However, guns recovered in connection with illegal carrying or possession would otherwise remain at plausibly greater risk for later use in a violent crime compared with guns kept at home by lawful possessors. Even in recoveries for which a nonviolent crime is recorded, circumstances often suggest a high risk of imminent violence.³¹

Our procedures for updating gun traces produced new information for only 11.5% of handguns, which results in part from our decision to search sales records beginning in 1996, 3 years before the guns were recovered. Failure by retailers to document sales, which is illegal, may also be a limiting factor; of 340 handguns recovered in Los Angeles in 1995 and traced to a California retailer, just 58% had a record in the state's sales archive.³² Missing data remained common even after updates were made.

Several steps could be taken to increase the utility of updating gun traces. Searches could be expanded back in time; these older "hits" would be of less value in solving individual crimes. Searches could include rifles and shotguns, 22.6% of our study guns, if those records were retained. Searches could be broadened to additional jurisdictions, which would be the most useful step; one third of guns in this study were last known to have been sold outside California. Few states compile the necessary data, however.³³

DISCUSSION

Our data suggest that the flow of guns from manufacture to criminal use is not random; there are patterns, analogous to a life cycle, that may allow for focused and more effective intervention. We discuss those patterns and their policy implications in the context provided by previous research.

There are well-defined high-risk groups for illegal gun possession and use. In this study, the peak incidence of gun possession per year of age was at ages 18 to 20 years. During our study year, the nationwide age dis-

tribution of crime gun possessors was similar¹¹; persons aged 18 to 20 years also had the highest incidence of arrest for murder, robbery, and aggravated assault.³⁴ Efforts to prevent illegal gun possession among young people are well founded.

There are "weapons of choice" for criminal use. Semi-automatic pistols made up 52.4% of the guns in this study and 59.6% of those recovered from young people nationwide in 1999.¹¹ Large-caliber handguns doubled as a proportion of all handguns as possessor age increased. This "caliber creep" likely represents increased access to more expensive guns among older possessors. Large-caliber pistols, favored by young people with a history of gun-related crime,³⁵ were most common among guns bought by purchasers of multiple traced guns or recovered from possessors who had bought the guns themselves.

Inexpensive pistols were ubiquitous, accounting for 3 of the 10 most frequently traced guns here and 7 of 10 for juveniles and 5 of 10 for young adults nationwide.¹¹ Among young people, buying an inexpensive pistol is associated with an increased risk of arrest for gun or violent crimes.²⁴ Maryland's ban on the sale of these guns has been linked to a 9% decrease in its homicide rate.³⁶

Rifles and shotguns were more common in California than elsewhere, making up 23.5% of our study guns but only 14.2% of guns recovered from young people nationwide.¹¹ Norinco 7.62-mm rifles, ranked second here, were not among the top 10 nationally.

Crime guns are new guns. The "new guns hypothesis"³⁷ holds that recently purchased guns are overrepresented among crime guns.^{11,12} We found this claim to be true for guns bought by purchasers of multiple study guns (median time to crime 2.2 years) and guns whose possessors were also their purchasers (median time to crime 0.5 years). But overall times to crime were longer in California than nationally¹¹ by 1 to 2 years for handguns and more for rifles and shotguns. The age of guns recovered from young people in California is comparable to that of guns in the general population.³⁸

California's longer times to crime may reflect policies that interfere with the movement of guns into illegal commerce.³³ The state has long required a waiting period and background check for sales by licensed retailers and in 1991 largely prohibited direct transfers of guns between private parties. In most states, private parties legally sell guns without establishing the buyer's identity, conducting a background check, or keeping records and can sell handguns to persons aged 18 to 20 years. Perhaps 40% of all gun transfers are between private parties.³⁸

California also prohibits violent misdemeanants from purchasing or possessing guns. Such persons are at high risk for involvement in crimes including guns or violence^{39,40} and plausibly more likely than others to engage in illegal gun commerce.

Crime guns change hands rapidly. Nationwide, only 11% of crime guns are recovered from their original purchasers.^{11,12} One benefit of updating traces is reducing this gap between purchaser and possessor; nearly half our cases of purchaser-possessor identity were made by state sales records.

Gun acquisition patterns varied with the possessor's age. Possessors aged 21 to 24 years most frequently had guns bought by persons of that same age, plausibly, given the shorter time to crime for their guns, someone known to them. For possessors younger than 18 years, the most frequent purchaser was a generation older, possibly an adult family member or, given the longer time to crime for these guns, a stranger separated by intermediate changes of possession.

Identifying the most recent purchasers of guns recovered from possessors younger than 21 years is particularly important. Persons aged 18 to 20 years cannot purchase handguns from licensed retailers but commit major violent crimes more frequently than anyone else. Surrogate "straw" purchasers are an important source of guns for this age group. In one survey, 32% of student-age correctional inmates and 18% of inner-city high school students had asked someone to purchase a gun for them from a retailer.^{41,42} During the late 1990s, most ATF trafficking investigations involving young people identified straw purchasers as the source of the trafficked guns.¹⁵

Straw purchasers are likely to buy multiple guns. In our data, nearly half the guns linked to purchasers of multiple guns came from transactions that retailers must report to ATF. Investigating these transactions can identify trafficking operations.¹³ Restricting gun purchases to 1 per person per month can also disrupt gun trafficking.⁴³

Crime guns are usually of local origin. Most guns recovered from young people, in this study and nationwide,¹¹ were of in-state origin. Many were sold and recovered in the same county. Half of ATF's gun trafficking investigations involving young people during the late 1990s concerned guns that were entirely of in-state origin.¹⁵ Local efforts to close down illegal gun commerce can be effective.⁴⁴ Out-of-state guns came disproportionately from a few states in this study and nationwide,¹¹ which facilitates interstate efforts to disrupt gun-trafficking routes.

A minority of retailers are disproportionately linked to crime guns. Just 10 retailers of some 3,500 in California accounted for 13.1% of guns in this study that were traced to a firearm licensee. Nationwide, 1.2% of retailers accounted for 57% of such guns in 1998.⁴⁵ In California in 1998, retailers with handgun traces that were more numerous than predicted by their sales accounted for 33% of handgun sales but 83% of handgun traces.⁴⁶ These findings suggest that enforcement can focus on a minority of gun retailers.

ATF has instituted more rigorous licensing and oversight policies,⁴⁷ leading to a decrease in licensed retailers by 74% for gun dealers and 12% for pawnbrokers, as of 2001, from peaks in the early 1990s.⁴⁸ The sellers of one third of crime guns traced in 1994 were out of business by 1998.⁴⁹ But recent studies^{13-15,32,33} emphasize the continuing importance of licensed retailers as sources of crime guns. Of ATF's trafficking investigations in the late 1990s, the 9% of cases involving corrupt retailers accounted for nearly half the trafficked guns, 40,365 guns in total.¹³

Ironically, law enforcement agencies have sometimes been important sources of crime guns, as they are here. Thousands of used law enforcement guns have entered the civilian market because agencies traded them for new weapons.^{50,51}

Six states have recently required that all recovered crime guns be traced by ATF.³³ Other states should consider similar action. Systematic data on recovered crime guns, linked to public health surveillance of violent events, could expand our capacity for early detection of conditions that facilitate violence and for early intervention. The number of firearm homicides increased each year during 1999 to 2002.^{52,53} Such expanded capacities are of critical importance if we are to limit a resurgence in America's epidemic of gun violence.

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