Temporal Trends in Spatial Access to Pharmacies that Sell Over-the-Counter Syringes in New York City Health Districts: Relationship to Local Racial/Ethnic Composition and Need

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ABSTRACT *Pharmacies that sell over-the-counter (OTC) syringes are a major source of sterile syringes for injection drug users in cities and states where such sales are legal. In these cities and states, however, black injectors are markedly less likely to acquire syringes from pharmacies than white injectors. The present analysis documents spatial and temporal trends in OTC pharmacy access in New York City health districts over time (2001–2006) and investigates whether these trends are related to district racial/ethnic composition and to local need for OTC pharmacies. For each year of the study period, we used kernel density estimation methods to characterize spatial access to OTC pharmacies within each health district. Higher values on this measure indicate better access to these pharmacies. "Need" was operationalized using two different measures: the number of newly diagnosed injection-related AIDS cases per 10,000 residents (averaged across 1999–2001), and the number of drug-related hospital discharges per 10,000 residents (averaged across 1999–2001). District sociodemographic characteristics were assessed using 2000 US decennial census data. We used hierarchical linear models (HLM) for descriptive and inferential analyses and investigated whether the relationship between need and temporal trajectories in the Expanded Syringe Access Demonstration Program access varied by district racial/ethnic composition, controlling for district poverty rates. HLM analyses indicate that the mean spatial access to OTC pharmacies across New York City health districts was 12.71 in 2001 and increased linearly by 1.32 units annually thereafter. Temporal trajectories in spatial access to OTC pharmacies depended on both need and racial/ethnic composition. Within high-need districts, OTC pharmacy access was twice as high in 2001 and increased three times faster annually, in districts with higher proportions of non-Hispanic white residents than in districts with low proportions of these residents. In low-need districts, "whiter" districts had substantially greater baseline access to OTC pharmacies than districts with low proportions of non-Hispanic white residents. Access remained stable thereafter in low-need districts, regardless of racial/ethnic composition. Conclusions were consistent across both measures of "need" and persisted after controlling for local poverty rates. In both high- and low-need districts, spatial access to OTC pharmacies was greater in "Whiter" districts in 2001; in high-need*

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districts, access also increased more rapidly over time in "whiter" districts. Ensuring equitable spatial access to OTC pharmacies may reduce injection-related HIV transmission overall and reduce racial/ethnic disparities in HIV incidence among injectors.

INTRODUCTION

In the USA, HIV incidence and prevalence are substantially higher for black injectors than for white injectors.[1–4] Eliminating these disparities is predicated, in part, on ensuring that all injectors can easily secure one sterile syringe each time they inject.[5] In states and cities that permit syringe acquisition and possession without a prescription, pharmacies are a major source of sterile syringes for local injectors.[6–13] Notably, however, studies conducted in several US cities have concluded that black injectors are substantially less likely to purchase syringes from a pharmacy than their white counterparts.[6,12–16] Here, we investigate one possible determinant of racial/ethnic differences in pharmacy utilization: racial/ethnic inequality in spatial access to pharmacies that sell syringes without a prescription. Specifically, in this longitudinal (2001–2006) analysis of New York City (NYC) health districts, we investigate whether the relationship between district-level need for sterile syringes and spatial access to pharmacies that sell syringes over the counter varies by district racial/ethnic composition. To help us better conceptualize this research topic, we develop the construct "racialized risk environments."

At the outset of the HIV/AIDS epidemic in the USA, most states had laws on their books that prohibited acquiring and/or possessing syringes without a prescription.[17] Enacted in the 1950s and 1970s, these laws were designed to curtail illicit drug use[17] but had the unintended consequence of fueling the HIV epidemic (and other blood-borne epidemics) among injectors by creating an artificial scarcity of syringes.[18–21] These laws have since been repealed or amended in many states in order to permit syringe exchange programs (SEPs) to operate and to restore pharmacists' ability to sell syringes over the counter (OTC) to injectors.[22] The resulting OTC syringe sales have emerged as a powerful tool to reduce HIV transmission. Panel studies of injectors living in areas that have repealed or amended these laws have consistently found reductions in syringe sharing after the legal change,[7,10,23–26] and jurisdictions that permit OTC syringe sales have lower prevalences of injection-related HIV than other juridictions.[18–21] Friedman and colleagues,[18] for example, found that HIV prevalence was almost six percentage points lower among injectors living in metropolitan areas that permit OTC sales than it was elsewhere in 1992.

The effects of these legal changes, however, have not been uniform: black injectors' acquisition of syringes from pharmacies appears to lag behind that of their white counterparts in jurisdictions that permit OTC sales.[6,12–16] NYC exemplifies this pattern. New York State began allowing pharmacies to sell OTC syringes in 2001. By the close of 2003, 79% of white injectors reported acquiring a syringe from a pharmacy in the past 6 months, compared to 35% of black injectors and 49% of Latino injectors.[6] Additional studies conducted in NYC, Anchorage, Alaska, and Hartford, CT echo these findings.[12–16]

Several studies have investigated the causes of racial/ethnic differences in pharmacy utilization and have focused in particular on the contribution of racial/ethnic discrimination.[11,15,27–29] While interpersonal racial/ethnic discrimination occurring during the purchasing event itself appears to be rare,[11,27–29] injectors' experiences with racial/ethnic discrimination during their lifetime powerfully determine syringe acquisition patterns. In a 2001–2003 study, Fuller and colleagues[15] found that injectors in NYC who reported experiencing racial/ethnic discrimination in their lifetime were 0.25 (CI 0.11, 0.58) times as likely to report purchasing syringes from a pharmacy in the past 6 months than other injectors. These investigators posit that individuals who have personally experienced racial/ethnic discrimination may hesitate to seek syringes through a pharmacist because they fear further mistreatment.[15]

Here, we explore the extent to which racial/ethnic inequalities exist in spatial access to pharmacies that sell OTC syringes; such inequalities may also contribute to racial/ethnic differences in pharmacy utilization among injectors. To help us better conceptualize this research topic, we develop the construct "racialized risk environments," a construct with roots in research on the "risk environment" and in critical race theory. Rhodes and colleagues have defined risk environments as the "space(s) .... (where) factors exogenous to the individual interact to increase chances of HIV transmission among drug users"[30] (p. 1027). Spatial access to programs supporting users' health is a key feature of the local risk environment for injectors: travel time to service sites shapes utilization of harm reduction programs and drug treatment programs (though see Bruneau and colleagues for a possible exception[31]).[32–35] An NYC-based study conducted in the mid-1990s, for example, found that injectors living within a 10-min travel distance of a local SEP were almost three times more likely to attend an SEP and half as likely to report receptive syringe sharing than other injectors.[32]

Critical race theory describes racialized social systems as "societies that allocate differential economic, political, social, and even psychological rewards to groups along racial lines"[36] (p. 44). We propose that risk environments are "racialized" when the presence of a particular protective or harmful feature varies across geographic areas according to their racial/ethnic composition. Drug-related arrests exemplify such a feature of the risk environment: The threat of arrest imperils injectors' ability to engage in harm reduction,[37–48] and drug-related arrest rates are higher in predominately Latino and/or Black communities, particularly those that are impoverished.[49,50]

We posit that spatial access to pharmacies selling OTC syringes is another racialized feature of injectors' risk environments. Several lines of inquiry support this hypothesis. First, as discussed above, black injectors are substantially less likely to report acquiring syringes from pharmacies; perhaps, racial/ethnic differences in spatial access to pharmacies contribute to this pattern. Second, per capita pharmacy presence may be lower in predominately black neighborhoods than it is elsewhere;[51] this may indicate lower spatial access to pharmacies in the former neighborhoods (regardless of whether they sell OTC syringes). Finally, pharmacies located in areas with higher proportions of non-Hispanic white residents may be more likely to offer goods and services that are associated with illicit drug use.[52,53] To illustrate, a 1997 survey of NYC-based pharmacies found that only 25% of pharmacies located in predominately non-white communities stocked opioid analgesics that were sufficiently potent to treat people in severe pain; in contrast, 72% of pharmacies in predominately white communities stocked this medication.[52] Spatial access to

pharmacies that sell OTC syringes may have a similar geographic distribution in jurisdictions where pharmacists can volunteer (or not) to sell OTC syringes.

We test our hypothesis in a longitudinal (2001–2006) study of NYC health districts, exploring in particular whether the relationship between district-level need for sterile syringes and temporal trends in spatial access to OTC pharmacies varies by district racial/ethnic composition. The study period 2001–2006 captures the early years of OTC sales in NYC. On January 1, 2001, New York State initiated the "Expanded Syringe Access Demonstration Program" (ESAP).[54] Under ESAP, pharmacies, healthcare facilities, and healthcare providers are permitted to sell up to ten syringes to adults without requiring a prescription.[54] During the study period, more than 98% of all ESAP providers were pharmacies.[55] Participation in ESAP is voluntary, and pharmacies (and other eligible providers) must enroll in ESAP to be legally permitted to sell OTC syringes to their customers.[54] Prior to ESAP's inception, state law prohibited the sale and possession of syringes without a prescription (unless syringes were acquired through state-sanctioned SEPs).[54]

METHODS
Unit of analysis. NYC health districts are the unit of analysis. Each health district consists of three to nine adjacent ZIP code areas whose residents have relatively similar sociodemographic characteristics.[56] We selected health districts as our unit of analysis because required data were available at this geographic scale and because the NYC Department of Health uses them to track and analyze local patterns of health outcomes and healthcare service delivery, e.g., New York City Department of Health and Mental Hygiene.[57] There are 42 health districts in the city, and their median population size in 2000 was 194,305 (range, 30,895–477,516).[58]

Variables. We analyzed several databases to measure district-level spatial access to ESAP pharmacies, need for sterile syringes, racial/ethnic composition, and poverty rates. We assessed spatial access to ESAP pharmacies for each year of the study period (2001–2006) because we assumed that ESAP registration would be particularly dynamic during this program's early years. All predictors were operationalized at one time point (approximately 2000), either because we did not anticipate substantial temporal changes in them during the study period (e.g., local poverty rates) or because annual data were not readily available (e.g., drug-related hospital discharge rates) or had substantial missing values for multiple years and districts.

District-level spatial access to ESAP pharmacies. Drawing on research on health services geography,[59–61] we define "spatial access to ESAP pharmacies" as a property of each health district that reflects the local availability of pharmacies enrolled in the ESAP program in a given year. This construct is distinct from "aspatial access," which refers to barriers and facilitators of healthcare access that are not rooted in geography (e.g., stigma[62,63]).[61,64] We also focus on *potential* spatial access to ESAP pharmacies, which concerns reasonable possible use, rather than *revealed* (or actual) service use.[61,65–67] We operationalized this construct in a two-stage process. In stage 1, we mapped all pharmacies enrolled in ESAP each year of the study period. In stage 2, we used kernel density estimation methods to calculate access to these pharmacies within each district for each year of the study period.[68,69]

Stage 1: Mapping ESAP pharmacy sites: The universe of ESAP pharmacies that NYC residents may reasonably use includes (1) all pharmacies located in NYC and (2) all pharmacies located in a 1-mile "buffer zone" encircling NYC's boundaries (excluding those that required crossing a body of water to reach).[70] We include the latter group of pharmacies in this universe because NYC residents may cross city boundaries to purchase OTC syringes (the rationale for a 1-mile buffer zone is discussed below). We obtained an inventory of all ESAP pharmacies in this universe from the New York State Department of Health. This inventory included each pharmacy's street address and enrolment year. A geocoding firm with a high accuracy rate (>96%) geocoded each pharmacy to its longitude and latitude point.[71]

Stage 2: Calculating district-level ESAP pharmacy access: We applied kernel density estimation (KDE) methods to calculate spatial access to ESAP pharmacies within NYC health districts over time.[68,69] KDE methods are commonly used to assess spatial access to health service sites.[72,73] These methods incorporate the number and proximity of service sites within defined geographic areas and allow access to decline with distance from the focal point. KDE calculates ESAP pharmacy access as a function of (1) the maximum distance (r) that an injector would reasonably travel to reach an ESAP pharmacy to purchase OTC syringes, (2) the Euclidean distance between Point A and each ESAP pharmacy within r distance of that point, and (3) a distance decay probability function that allows access to decline as distance increases between point A and the pharmacy (as is common,[68,69] the quartic kernel function was used here). The resulting measure can be loosely interpreted as capturing the density of ESAP pharmacy sites per square mile, though note that this interpretation ignores the density decay formula.[74]

No data yet exist on the reasonable maximum travel distance that an injector will travel to reach an ESAP site. We set $r=1$ mile based on Rockwell and colleagues'[32] conclusion that injectors living within a 10-min travel distance of an SEP are almost three times more likely to report using an SEP. In NYC, we assume that people walk approximately half a mile in 10 min; we set r equal to twice this value (1 mile), recognizing that access values approach zero as r approaches its maximum value. ESAP pharmacy access for each district was calculated by averaging spatial access values for all points within that district.

District Need. Need refers to the local demand for sterile syringes among injectors. Ideally, this construct would be operationalized as the number of injectors living in each health district or as the total number of injections occurring within the district. These data, however, are unavailable. Instead, we used two imperfect measures of need for each district: the prevalence of newly diagnosed injection-related AIDS cases per 10,000 residents and the prevalence of drug-related hospital discharges per 10,000 residents. Both measures were obtained from the New York State Office of Alcoholism and Substance Abuse Services' Prevention Risk Indicators Services Monitoring System and are the average prevalence across 1999–2001.[75] The drug-related hospital discharge variable captures all patients with any drug-related diagnosis in their record (excluding alcohol).[75]

District Sociodemographic Characteristics. We assessed district racial/ethnic composition (operationalized as the proportion of residents who were non-Hispanic White) and poverty rates using 2000 US Decennial Census data. ZIP code tabulation areas were used to approximate the ZIP codes that constitute NYC health districts.

Analysis

We conducted exploratory data analysis to identify the central tendency, location, and dispersion of each variable.[76] To model the relationships among the predictor variables and the outcome, we used hierarchical linear models (HLM). In longitudinal studies of geographic areas, HLM treats time as nested within the spatial unit of analysis and characterizes the structure of change by identifying the mean trajectory across all units (expressed as "fixed effects") and quantifying inter-unit variation around this mean trajectory (expressed as "random effects").[77] Predictor variables were mean-centered to facilitate interpretation.[77] We first ran a growth curve model (i.e., a model in which time was the only predictor) to explore temporal trends in ESAP access over the study period (model A). We next explored whether baseline need (operationalized initially as injection-related AIDS prevalence) shaped this temporal trend (model B) and then whether baseline racial/ethnic composition moderated the relationship between need and temporal trends in ESAP access (model C). The final model controlled for local poverty rates in 2000 (model D). Models B, C, and D contain interactions (model B, study year×need and models C and D, study year×need×racial/ethnic composition). Interactions were probed using pick-a-point and Johnson–Neyman methods.[78,79] Pick-a-point methods move beyond the omnibus test of an interaction to explore the nature of the regression of X on Y at different levels of the moderator (usually high vs. low).[78,79] Johnson–Neyman methods identify the values of the moderator where the regression of X on Y shift from non-significance to significance.[78,79] Here, we followed the usual practice of calculating "high" and "low" values as one standard deviation above and below the mean, respectively, on each focal variable.[80]

We re-ran all analyses using drug-related hospital discharge rates as our measure of need. To facilitate comparisons of model results across our two measures of need, we standardized both need variables for this set of comparative analyses.

Model diagnostics indicated that one district was highly influential when need was operationalized as drug-related hospital discharge rates. As discussed in more detail in the results section, we removed this single observation from analyses in which need was measured as the drug-related hospital discharge rate to better characterize the overall relationships among our variables across the vast majority of districts. All geospatial analyses were conducted using ArcInfo.[81] Statistical tests were conducted in SAS 9.2.[82]

RESULTS

Spatial access to ESAP pharmacies during the first years of this program's existence varied across both health districts and over time (see Figure 1). During ESAP's inaugural year, the median spatial access value across NYC's 42 health districts was 8.00 pharmacies per square mile (interquartile range, 4.99, 13.12). Over the 6-year study period, this median value increased by 47%, to 11.76 pharmacies per square mile. There was considerable dispersion across districts around these annual median values, and this dispersion increased over time. The width of the interquartile range (IQR) increased by 75% over time, from 8.13 in 2001 to 14.45 in 2006. As is

Y axis label: Spatial density of ESAP pharmacies per square mile within NYC health districts
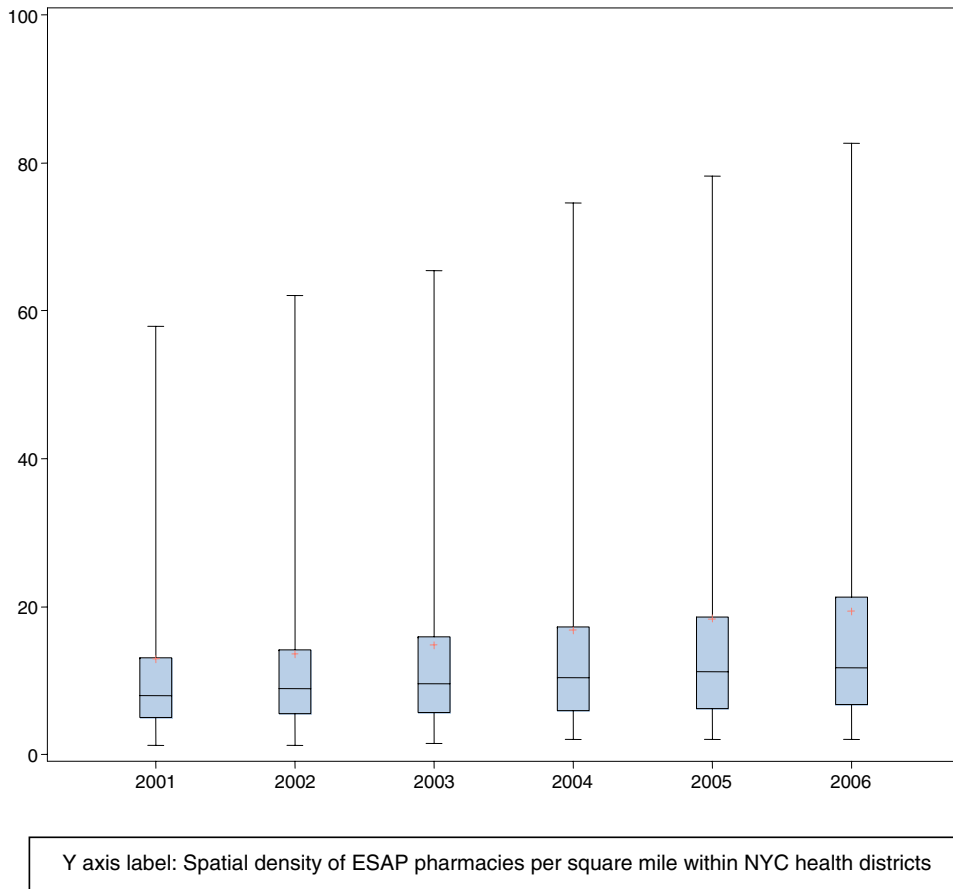
FIGURE 1. Box and whisker plots of spatial access to pharmacies enrolled in New York State's Expanded Syringe Access Demonstration Program (ESAP) across New York City's 42 health districts between 2001 and 2006.

evident in Figure 1, the preponderance of this increase occurred at the upper end of the distribution. Additional examination of the data indicates that increases in spatial access were greatest in districts that had high baseline spatial access to ESAP sites.

There was considerable dispersion across districts in our two measures of need and in local racial/ethnic composition and poverty rates (Table 1). The median prevalence of newly diagnosed cases of injection-related AIDS was 1.43 per 10,000 residents, with an IQR spanning 0.88–2.20 per 10,000. The median rate of drug-related hospital discharges per 10,000 residents was 103.57, with an IQR of 59.57–213.32.

Results from the growth curve model (Table 2, model A) suggest that the mean ESAP access value across districts was 12.71 pharmacies per square mile in 2001; average access increased by 1.32 pharmacies per square mile annually thereafter. Districts varied significantly around this mean trajectory. Analyses of random effects indicate that districts with high initial spatial access had greater annual rates of change than districts with lower access in 2001.

Results from model B indicate that need, measured as the prevalence of newly diagnosed injection-related AIDS cases in 1999–2001, is positively and significantly related to the rate of change in ESAP access over time, though it has no statically significant impact on ESAP access at baseline (i.e., the coefficient for the relationship

TABLE 1 Distribution of key predictor variables across New York City's 42 health districts

Variable (year)	Median	Interquartile range
Rate of newly-diagnosed injection-related AIDS cases per 10,000 residents (averaged across 1999–2001)	1.43	0.88, 2.20
Rate of drug-related hospital discharges per 10,000 residents (averaged across 1999–2001)	103.15	59.57, 213.32
Percent of residents who are non-Hispanic white (2000)	41.24%	10.94%, 59.49%
Poverty rate (1999)	17.14%	12.82%, 30.67%

of need with baseline ESAP pharmacy access is 1.56 and is not statistically significant; Table 2). For example, by probing this interaction, we find that, while both low- and high-need districts (i.e., districts where the prevalence of injection-related AIDS was one standard deviation below and above the mean, or 0.59 and 2.99 per 10,000 residents, respectively) had approximately equivalent spatial access at the start of the study period (spatial access values of about 12.00), the annual rate at which access increased was more than twice as high in a high-need district than it was in a low-need district (1.83 and 0.80, respectively). Johnson–Neyman analyses indicate that the impact of need on spatial access trajectories was significant for values of this moderator that exceeded 0.20 injection-related AIDS cases per 10,000

TABLE 2 Relationship of "need" (operationalized as the prevalence of newly diagnosed cases of injection-related AIDS per 10,000 residents), racial/ethnic composition, and poverty rates to temporal trajectories in spatial access to pharmacies enrolled in the Expanded Syringe Access Demonstration Program (ESAP) in New York City health districts over time (2001–2006)

Predictor	Model A	Model B	Model C	Model D
Fixed effects				
Intercept	12.71***	12.74***	16.48***	16.42***
Year	1.32***	1.31***	1.68***	1.68***
Need		1.56	10.23***	10.43***
Need×year		0.43*	1.25***	1.25***
Percent of residents who are Non-Hispanic white			38.56***	37.56***
Percent of residents who are non-Hispanic white×Year			3.61***	3.61***
Percent of residents who are non-Hispanic white×Need			20.05**	19.72*
Percent of residents who are non-Hispanic white×need×Year			1.94**	1.94**
Poverty rate				−5.39
Random effects				
Variance among the intercepts	168.92***	165.76***	96.98***	96.52***
Correlation of intercepts and slopes	0.96***	0.99***	0.99***	0.99***
Variance among the slopes	1.77***	1.48***	0.87***	0.87***
Ar(1)[a]	0.60*	0.66*	0.66*	0.66*
Residual variance	1.50*	1.78	1.76	1.79

*$p<0.05$; **$p<0.001$; ***$p<0.0001$
[a]Within district covariance, assuming a first-order autoregressive error structure

residents; almost all districts (41 of 42) had AIDS prevalence values that exceeded this cut point. Further analyses of the model's random effects indicate that need accounted for 1.9% of the variation in ESAP access across districts in 2001 and for 16.4% of the variation across districts in the rate of change in access over time.

The relationship between need and temporal trajectories in spatial access, however, depends on local racial/ethnic composition (Table 2, model C; Figure 2). Specifically, the relationships of need to baseline ESAP access and of need to temporal trajectories in ESAP access are stronger in districts that have higher percentages of non-Hispanic white residents. For example, in a high-need district with a high proportion of non-Hispanic white residents (i.e., a district where 64% of residents are non-Hispanic white and where there are 2.99 newly diagnosed injection-related AIDS cases per 10,000 residents), the model-based mean baseline ESAP access value was 39.02 pharmacies per square mile. In contrast, baseline ESAP access was less than half this value (18.82) in a high-need district with a low proportion (12%) of non-Hispanic white residents. "Whiter" high-need districts also experience greater increases in access over time than other high-need districts. The model implies that a high-need, predominately non-Hispanic White district experienced average annual increases in ESAP access of 4.71 pharmacies per square mile, whereas a high-need district with a low proportion of this racial/ethnic group gained only 1.64 pharmacies per square mile annually on average (Figure 2). Johnson–Neyman analyses indicate that district racial/ethnic composition moderated the relationship between need and ESAP access in high-need districts across all values of racial/ethnic composition found in our database.
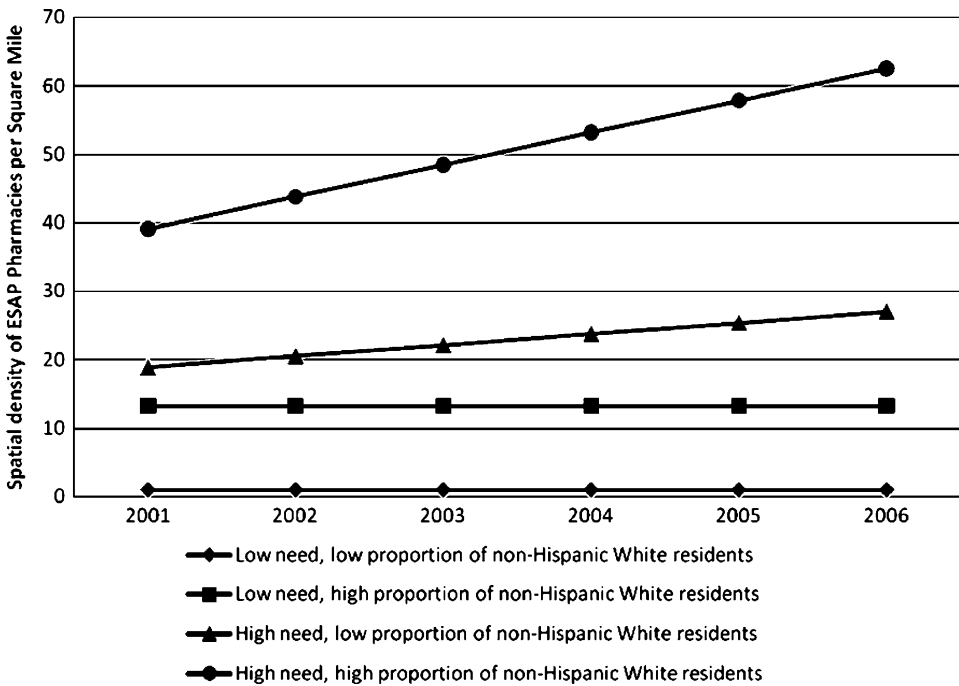
FIGURE 2. Model-based temporal trajectories of spatial access to New York City pharmacies enrolled in the Expanded Syringe Access Demonstration Program (ESAP) across NYC health districts, according to district need (measured as newly diagnosed cases of injection-related AIDS per 10,000) and the proportion of residents who are non-Hispanic White.

In contrast, our analyses reveal that racial/ethnic composition is irrelevant to the relationship between need and changes in ESAP access in low-need districts. In low-need districts (regardless of district racial/ethnic composition), access remained static over the study period. District racial/ethnic composition, however, does moderate the relationship between need and access at baseline (Figure 2). In 2001, residents of a low-need district with a low proportion of non-Hispanic white residents (i.e., a district where 12% of residents are in this racial/ethnic group and with 0.59 cases of newly diagnosed injection-related AIDS per 10,000 residents) had no ESAP access in 2001 on average; in contrast, residents of a low-need, predominately non-Hispanic white district had a mean baseline ESAP access value of 13.25 pharmacies per square mile.

Analyses of the random effects indicate that racial/ethnic composition accounted for 43% of inter-district variation in spatial access to ESAP at baseline and for 50.9% of inter-district variation in trends in ESAP access over time. Adding poverty to a model that already contained local racial/ethnic composition and need had a negligible effect on the magnitude or significance of any variables (Table 2, model D).

We re-ran our analyses with need operationalized as the prevalence of drug-related hospital discharges among adult residents in 1999–2001 and reached substantively similar conclusions to those described above once we had removed one high-leverage outlier (the Stapleton-St. George health district) from the model (a high-leverage outlier is a case that has an extreme value on a predictor, and distorts regression results; Online Table 1). As noted in a recent NYCDOH report,[83] Stapleton-St. George has a high drug-related hospital discharge rate (twice that of the city's overall); it is also a predominately non-Hispanic white district with low spatial access to ESAP pharmacies. To allow us to better characterize focal patterns across the vast majority of districts, we removed Stapleton-St. George from analyses in which need was measured as drug-related hospital discharge rates.

DISCUSSION

Our analyses indicate that spatial access to pharmacies that sell OTC syringes increased substantially in the early years of NYC's ESAP initiative. The greatest increase in spatial access to ESAP pharmacies occurred during this initiative's inaugural year, when access rose from 0 on December 31st 2000 to a model-based mean of 12.71 pharmacies per square mile across districts by the close of 2001. Model-based means increased steadily thereafter by 1.32 units annually. There was, however, considerable inter-district variation around this mean trajectory. Local need and racial/ethnic composition interacted to shape this variation. The relationship between need and spatial access to ESAP pharmacies was markedly attenuated in health districts that were home to lower proportions of non-Hispanic White residents. Among high-need districts, "whiter" districts had about twice the spatial access to ESAP pharmacies at baseline than districts with a low proportion of non-Hispanic white residents (39.02 vs. 18.82 pharmacies per square mile). This inequality increased over time: the model-based mean annual growth rate in the former districts was about three times that in the latter districts (4.71 vs. 1.64). In low-need districts, our model indicates that "whiter" districts had ESAP access values of 13.25 in 2001; districts with a low proportion of non-Hispanic white residents had no access to ESAP pharmacies that year. This inequality remained stable over the study period: ESAP access did not increase over time in low-need districts, regardless of their racial/ethnic composition.

Notably, a positive relationship existed between need and ESAP access across all levels of district racial/ethnic composition. This is heartening, as past research, conducted at a larger geographic scale (i.e., US metropolitan areas), has found no relationship between the local need for sterile syringes and SEP presence or between the local need for drug treatment and treatment coverage for injectors.[84,85] However, in the present analysis, racial/ethnic composition was a far more powerful predictor of access trajectories than local need at baseline. District racial/ethnic composition accounted for 43% of inter-district variation in spatial access to ESAP in 2001; baseline need accounted for less than 2% of this variation. Likewise, racial/ethnic composition accounted for 50.9% of inter-district variation in growth rates in ESAP access, while baseline need accounted for 16.4% of this variation. This conclusion echoes past work that has found that the spatial distribution of harm reduction sites and services is largely shaped by sociopolitical processes.[63,84,85]

Our analyses thus suggest that ESAP access is a racialized feature of the risk environment in NYC health districts; that is, it appears to be a protective feature that is distributed across geographic areas according to local racial/ethnic composition. This distribution may have several implications. Given the salience of proximity to determining injectors' use of harm reduction services and drug treatment,[32–35] the racialized distribution of ESAP access may help explain the lower rates of ESAP pharmacy utilization among black injectors in NYC if the racial/ethnic composition of injectors across districts follows that of the general population. Planned multilevel analyses that combine district-level data on spatial access to ESAP with individual-level data on ESAP use among injecting district residents will allow us to explore this possibility.

While easy access to a new, sterile syringe for each injection event is vital for all injectors,[5] constraints on black injectors' access to such syringes are particularly concerning. Black injectors tend to have higher HIV prevalences in their drug use networks than other injectors.[1] On average, then, a single receptive syringe sharing event carries a greater risk of HIV transmission for these injectors than it does for other injectors, controlling for viral load.[1] The current racialized distribution of spatial access to ESAP pharmacies in NYC may hinder progress toward eliminating HIV transmission among injectors overall and toward eliminating racial/ethnic disparities in HIV incidence among injectors.

Also of concern is the possibility that the spatial distribution of ESAP access may approximate a mirror image of the spatial distribution of drug-related arrests in NYC and perhaps elsewhere. As noted above, drug-related police activity is another racialized feature of the risk environment: Rates are higher in areas with lower proportions of non-Hispanic white residents and impede injectors' ability to engage in harm reduction. In particular, elevated arrest rates and resulting fear of arrest among local drug users reduce SEP utilization,[39,47,86,87] in part because SEP utilization renders one visible as a drug user to local police. A recent study suggests that reductions in SEP utilization in heavily policed setting are particularly strong for black injectors.[39] In these settings, pharmacies may be vital sources of sterile syringes because they allow injectors to acquire sterile syringes without revealing themselves as illicit drug users to local police,[15] though some may still hesitate to carry syringes (regardless of source) in heavily policed areas.[38] The inverse spatial distribution of these two racialized features of the risk environment (i.e., drug-related police activity and ESAP access) may thus confound injectors' harm reduction efforts where they are most needed.

Broadly speaking, the distribution of spatial access to ESAP pharmacies found here can be conceptualized as part and parcel of a racialized social system in which harms and resources are allocated according to individual race/ethnicity and according to collective racial/ethnic composition (depending on the scale of inquiry).[36,48] Seen in this light—and provided that the racial/ethnic composition of injectors across NYC health districts parallels that of the general population—our findings echo, at a structural level, Fuller and colleagues'[15] conclusion that interpersonal racial/ethnic discrimination discourages OTC syringe acquisition among black injectors.

The proximal determinants of the distribution of this particular resource across health districts, however, are unknown and require exploration. Possible explanations are that (1) pharmacies located in districts with lower proportions of non-Hispanic white residents may be less likely to enroll in ESAP,[52,53] (2) these districts may simply have fewer pharmacies,[51] and (3) some combination of items 1 and 2. Strategies to reduce inequality in spatial access to OTC pharmacies should rest on the specific nature of the determinants of this inequality. The NYSDOH has conducted extensive outreach to pharmacy chains operating in NYS, and approximately 70% of ESAP sites statewide are chains.[88] Possibly, chain pharmacies have less coverage of urban communities that have low percentages of non-Hispanic white residents. Uptake among unenrolled pharmacies could be increased by altering state law to mandate pharmacy participation; a promising multilevel educational intervention recently developed by Fuller and colleagues[89] could ease pharmacist resistance to ESAP. In areas where pharmacies are rare, encouraging other healthcare providers to enroll in ESAP may be necessary, as might the establishment of publicly operated pharmacies. Expanding SEPs and satellite syringe exchange are necessary interventions but are not sufficient, given these interventions' limited hours and geographic coverage and injectors' concerns about arrest.

These findings should be interpreted in light of several limitations. Our measure of ESAP access likely underestimates true spatial access to these sites because we did not account for injectors' activity patterns (which might routinely take them into other districts where they can purchase OTC syringes) or for public transportation patterns. More detailed, self-report data on injector travel patterns are required to create these measures and, to our knowledge, are currently unavailable. Another limitation might cause us to overestimate ESAP access: Some pharmacies may have chosen to exit the ESAP program or may have closed during the study period. At the time we received the inventory of ESAP pharmacies from the NYSDOH, this agency was not collecting data on ESAP dropout. This limitation would cause us to overestimate spatial access to ESAP pharmacies, and this overestimation would increase with each passing year. We note, however, that our main finding—that the relationship between need and access is moderated by local racial/ethnic composition—existed at baseline, a year when we expect that few ESAP pharmacies would have withdrawn from this initiative or closed. In addition, our measure could not capture access to OTC syringes as it unfolded on the ground. In NYC and elsewhere, staff members at pharmacies that sell OTC syringes sometimes introduce barriers to purchasing these syringes (e.g., requiring that customers sign logs to purchase OTC syringes);[28,90] the likelihood that staff engage in such discouraging practices may vary according to district need, racial/ethnic composition, and poverty rates.

No randomly drawn samples of injectors within health districts exist, and thus, we have no accurate data on the racial/ethnic composition of injecting populations in these districts. Discussions about the relationships of the racialized distribution of

ESAP access over time and space to racial/ethnic differences in ESAP utilization among individual injectors are thus speculative and depend on the assumption that the racial/ethnic composition of injectors in districts somewhat parallels that of the general population. Likewise, we have no information on the number of injectors living in each district or on HIV or overdose incidence among injectors living in these districts and were thus unable to directly measure need for ESAP. Notably, the direction and statistical significance of all focal relationships were similar across our two proxy measures of need; this robustness suggests that we may have captured the actual relationships of local need for sterile syringes with ESAP access and racial/ethnic composition.

Finally, data for this study pertained exclusively to NYC; the generalizability of our findings to other settings is thus unknown. The existence of racial/ethnic differences in OTC pharmacy use in several US cities suggests that spatial access to such pharmacies may be a racialized feature of the risk environment elsewhere as does the resonance of our findings with past research on the allocation of goods and services across racial/ethnic groups in the USA.

In conclusion, this analysis suggests that spatial access to OTC pharmacies is a racialized feature of the risk environment in NYC. Future multilevel analyses that include individual-level data on injectors can investigate whether and how this racialized feature of the risk environment generates racial/ethnic differences in OTC pharmacy use and risk behavior evident in NYC and elsewhere. Additionally, identifying and intervening in the specific determinants of racialized access to OTC pharmacies may help to reduce HIV transmission among injectors overall and to eliminate racial/ethnic disparities in HIV incidence.

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