

RESIDENTIAL MIGRATION AS A SOLUTION TO THE DRUG OVERDOSE EPIDEMIC

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ABSTRACT

Aims: To determine if residential relocation to a different county by drug dependent former prisoners lowers their likelihood of reincarceration.

Design: This study uses Hurricane Katrina as a natural experiment to determine whether residential relocation induced by the hurricane affected the likelihood of reincarceration among former prisoners. The study draws upon prisoner data provided by the Louisiana Department of Public Safety and Corrections, including information on place of residence pre- and post-prison, drug dependence, participation in drug treatment programs, and reincarceration.

Setting: New Orleans metropolitan area

Cases: The pre-Katrina cohort is comprised of individuals released from Louisiana prisons from September 2003 to February 2004 who had a history of drug abuse ($N = 788$). The post-Katrina cohort is comprised of releases from a Louisiana prison immediately after the hurricane, from September 2005 to February 2006 ($N = 676$).

Measurements: Reincarceration, the dependent variable, refers to a return to a Louisiana prison for a new criminal conviction or a parole violation within one year of prison release. Residential relocation is measured as a change in parish of residence from the period immediately prior to imprisonment to the period immediately upon release from prison.

Findings: Instrumental variables analysis reveals that the probability of reincarceration is 0.10 lower for individuals who relocated to a new parish upon their exit from prison relative to individuals who returned to their home parish, with a 95 percent confidence interval ranging from -0.191 to -0.017. An estimated 10 percent of parolees who moved were reincarcerated within one year of their release from prison versus 20 percent of the stayers.

Conclusions: Residential relocation by drug dependent former prisoners significantly reduces their likelihood of reincarceration. Relocation is consequential because it separates individuals from criminal peers, opportunities for drug use, and environmental cues associated with prior drug use.

Key Words: residential relocation, migration, Hurricane Katrina, recidivism, incarceration, crime, drugs, substance abuse, addiction, cue reactivity

INTRODUCTION

The Centers for Disease Control estimates that more than 72,000 people died from drug overdoses in the United States in 2017, which represents a 12 percent increase over the previous year and nearly a 50 percent increase over the past three years [1]. In fact, unintentional poisoning, of which drug overdoses account for the vast majority, is the leading cause of death among 25-44 year olds [2, 3]. More than two-thirds of the overdose deaths in 2017 were attributable to opioids, particularly synthetic opioids such as fentanyl [1].

Additional consequences of drug abuse beyond overdose and death include crime and imprisonment. Nearly 60 percent of state prisoners nationally have some form of drug dependence or a history of abuse and more than 70 percent were regular users of drugs at the time of their imprisonment [4]. More than half of released prisoners are reimprisoned for new crimes or parole violations within just three years [5]. In fact, national recidivism rates are essentially unchanged over the past several decades despite unprecedented spending on incarceration [5, 6, 7]. Drug abuse is widely regarded to be one of the most consequential of the dynamic risk factors of reoffending.

A likely contributor to the cycle of recidivism as well as drug relapse is the fact that many released prisoners return home to the same environment with the same criminal peers and opportunities for drug use that proved so detrimental to their behavior in the past. Many ex-prisoners move back to home neighborhoods despite an expressed interest to avoid such places because of a lack of housing opportunities elsewhere [8].

Returning to old neighborhoods may be particularly problematic for former prisoners with substance use disorders. Through a process of conditioning, persons addicted to drugs come to associate certain stimuli, called cues, with the use of a drug. Cues are commonly categorized as either substance-specific cues such as seeing a syringe or crack pipe or personal cues specific to an individual such as a seeing a person with whom a substance was used in the past or a place where it was used. Given the influence of personal cues, individuals may be more likely to relapse in environments associated with prior drug use [9, 10]. In the presence of familiar stimuli, individuals with an addiction may encounter a physiological reaction including an intense craving for drugs, and this reaction may still occur even after long periods of abstinence [11]. Research reveals that individuals may not even consciously notice a visual cue associated with prior drug use, but their brains may still react to the cue [12]. Hence, individuals may be primed for drug relapse without even knowing it, and fall back into active addiction without being able to even understand what initially prompted the return to drug use.

Conversely, if relapse into drug use is influenced by exposure to familiar social environments associated with prior use, then residential relocation to an area far removed from such environments may decrease the likelihood of relapse and associated behaviors such as crime. One of the most compelling studies to date in support of the hypothesis that a geographic change promotes and sustains cessation from drug use is Lee Robins's landmark study of desistance from heroin use among Vietnam veterans [13, 14]. Robins found that only five percent of veterans who were addicted to heroin upon leaving Vietnam had relapsed into active addiction by one year later. Just 12 percent of the prior heroin addicts had relapsed into active addiction at any point in the first three years after returning to the United States. Robins concluded that

participation in drug treatment did not explain the findings; the vast majority of individuals who recovered from heroin addiction upon their exit from Vietnam did not participate in drug treatment.

Critically, Robins's results were no fluke. Several studies of individuals addicted to opiates, opioids, and injectable drugs have similarly found evidence of a beneficial effect of residential change on abstinence and desistance from drug use [15, 16, 17]. For instance, in a study of opioid dependent individuals originally from San Antonio, authors found that the frequency of abstinence from opioid use lasting at least one-year was more than three times greater among individuals who had moved away from San Antonio (17 percent) than in instances where sample members had instead received treatment or been incarcerated (six percent) [18]. In another study, of a sample of injection drug users originally from Vancouver, individuals who subsequently moved out of the Greater Vancouver area were significantly less likely to use heroin and cocaine during the post-move follow-up period relative to the pre-move period whereas a control group of non-movers demonstrated no significant change in the frequency of heroin or cocaine use [19]. Hence, based on extant research, residential relocation of a sufficient distance outside of an origin location appears to promote abstinence and recovery from drug abuse.

Whereas there is promising evidence about the importance of residential relocation for cessation of drug use and a decline in associated problems such as criminal behavior, extant research suffers from the problem of selection bias. Existing studies tend to compare movers to non-movers, either without any statistical controls or with a limited number of controls. However, estimating the causal effect of place of residence on the likelihood of relapse or criminal recidivism is complicated by selection bias—the possibility that some unmeasured characteristic of individuals influences both where they live and their drug-related behavior, and may therefore account for any relation between residential relocation and both relapse and recidivism. People who move away from former places of residence may be fundamentally different in unobserved ways than individuals who tend to remain embedded in familiar residential settings, and these unobserved characteristics may explain the decline in drug use rather than the relocation to a new physical and social environment.

Natural Experiment

In this study, I use Hurricane Katrina as a natural experiment for estimating the effect of residential relocation on the likelihood of reincarceration among drug dependent individuals released from prison in Louisiana. In August 2005, Hurricane Katrina ravaged the Louisiana Gulf Coast, effectively damaging a vast majority of the housing stock in the New Orleans metropolitan area. In Orleans Parish, 71.5 percent of housing units suffered some damage following Hurricane Katrina, with 56 percent of housing units significantly damaged (note: parishes in Louisiana are equivalent to counties in other states) [20]. The extent of housing unit destruction was similar in the adjacent parishes that make-up the wider New Orleans metropolitan area.

One consequence of the property destruction from Hurricane Katrina was a dispersion post-Katrina of Louisiana parolees away from select New Orleans metropolitan neighborhoods to other residential locations throughout the state (parolees are required to remain in-state, unless they are granted a special transfer). For instance, Figure 1 draws on data from the Louisiana

Department of Public Safety and Corrections (DPS&C), and provides a snapshot pre- and post-Katrina indicating whether newly released prisoners returned to their home parish upon release from prison or moved to a different parish. Prior to Hurricane Katrina, roughly 23 percent of parolees with a history of drug dependence moved away from their pre-prison parish. Post-Katrina, this distribution doubled, with 46 percent of exiting prisoners migrating to a different parish. Thus, Hurricane Katrina fundamentally altered prevailing geographic patterns of residence for released prisoners in Louisiana, at least during the first year after the hurricane. For prisoners released soon after Hurricane Katrina, their residential choices were significantly different than if they had been released prior to the hurricane, resulting in some measure of geographic displacement. This exogenously induced change in the residential patterns of former prisoners provides me analytic leverage for investigating the causal effect of residential relocation on the likelihood of reincarceration among drug dependent former prisoners.

[FIGURE 1 HERE]

METHODS

Data and Sample

The analysis to follow draws on data on parolees from the DPS&C, including information on the residential addresses of parolees and whether parolees were reincarcerated within one year of their release from prison (i.e., the outcome variable). The research design and hypothesis of the study were pre-registered on Open Science Framework (<https://osf.io/dnxm2/>), although the data were obtained from the DPS&C prior to registration as part of another study [8]. Roughly 90 percent of prisoners released from Louisiana prisons during the years of observation were released onto parole supervision (in contrast to unconditional releases, which do not require post-incarceration supervision). Because my interest is in residential displacement due to Hurricane Katrina, I restrict analyses to those prisoners who resided in affected metropolitan areas prior to incarceration. Accordingly, the analytic sample only includes ex-prisoners who were originally committed to prison from Orleans Parish or the four parishes adjacent to Orleans which make-up the wider New Orleans metropolitan area (Jefferson, Plaquemines, St. Bernard, and St. Tammany). Additionally, because my interest is in the post-release behavior of individuals with a history of drug dependence, I restrict the sample to individuals assessed as having a history of drug abuse as measured by the Louisiana Risk/Needs Assessment (LARNA) instrument. This risk assessment is completed within the first two months after an individual is released from prison onto parole supervision, as a means of assessing the risk of criminal recidivism. In addition to assessment items related to drug abuse, the LARNA risk score is also based on static and dynamic risk factors including, among others, criminal history, a history of mental health problems, and current and past employment.

The analytic sample is drawn from prisoners released from Louisiana correctional facilities in two separate time periods, pre and post-Katrina. The pre-Katrina cohort is comprised of all releases from a Louisiana prison to parole supervision anytime from September 2003 to February 2004 who had a history of drug abuse ($N = 788$). The post-Katrina cohort is comprised of releases from a Louisiana prison to parole supervision immediately after the hurricane, from September 2005 to February 2006 ($N = 676$). Just over 65 percent of all individuals released to

parole supervision in the pre-Katrina period were assessed as having a history of drug abuse. The figure for the post-Katrina cohort is 62.3 percent. These rates are comparable to national estimates [4]. Given the nature of their offense, sex offenders face a number of constraints on their residency choices upon release from prison. Because of this, I opt to exclude these individuals from the study.

Measures

Data utilized in this study cover three domains: (a) individual-level data on parolees from the DPS&C and the Division of Probation and Parole (DPP), (b) parish-level socioeconomic characteristics from the U.S. Department of Housing and Urban Development, the Louisiana Department of Labor, and ESRI [21], and (c) Louisiana criminal justice system data from the Supreme Court of Louisiana, DPS&C, DPP, and the Uniform Crime Reports. The dependent variable, reincarceration, and the main independent variable, residential relocation, derive from the DPS&C data. Reincarceration refers to a return to a Louisiana prison for a new criminal conviction or a parole violation within one year of prison release. Residential relocation is measured as a change in parish of residence from the period immediately prior to imprisonment to the period immediately upon release from prison.

The analyses statistically adjust for differences between movers and stayers in individual characteristics that may be related to recidivism as well as differences in the socioeconomic context of where they live and the functioning of the criminal justice system. Statistical controls at the individual-level include race, gender, marital status, age at time of release, time served in prison, incarceration history, and the LARNA risk need assessment score. I also control for socioeconomic conditions measured at the parish-level (segregation, income inequality, the unemployment rate, average weekly wages, and fair market rents), as well as various indicators of criminal justice system operations (judge caseloads, the likelihood of arrest following the commission of a crime, average parole contacts per parole officer, and the reincarceration rate in the parolee's parole district during the six months prior to when he or she was released from prison). The use of statistical controls further enhances my ability to isolate the specific effect of residential relocation on reincarceration.

Analytic Strategy

Conceptually, I seek to examine what would happen to the behavior of the same individual under two different circumstances: he or she moved to a new parish upon release from prison or stayed in the same parish. Yet, it is only possible to observe one of these two potential outcomes for an individual at a given point in time (i.e., either the individual moved or did not). If, instead, one simply compares outcomes for movers and stayers, the estimate of the effect of moving may be biased because of omitted confounding variables related to the reasons why an individual moves. One solution to this problem of omitted variables is the use of instrumental variables (IV).

One key assumption of the IV framework is that the instruments and the outcome variable are unrelated, except through the treatment condition [22, 23]. This is known as the exclusion restriction. If we can find a variable that is (1) correlated with the treatment variable, yet is (2) uncorrelated with the dependent variable except through the treatment variable, we can use such a variable as an instrument. A common criticism of using IVs is that it is difficult to satisfy this second condition. However, we can have more confidence that the instrument and outcome are

related only through the treatment if the instrument derives from a random force of nature like a hurricane. In this case, a variable representing a natural occurrence is used as a predictor (instrument) of the treatment variable, and then the outcome variable is regressed on the *predicted* treatment measure. An IV remedies the issue of omitted variables by using only a portion of the variability in the treatment variable that is uncorrelated with omitted variables to estimate the causal relation between the treatment and outcome.

In the analyses below, I use the timing of release from prison — i.e., pre-Katrina (=0) or post-Katrina (=1) — to predict the treatment condition (i.e., whether the individual moved to a new parish). I then regress the outcome variable — reincarceration within one year — on the *predicted* treatment measure. Conceptually, this approach removes the spurious correlation between the treatment variable and unobserved characteristics, in this case unobservable characteristics of parolees. I implemented this IV analysis in Stata with the *ivprobit* command. Postestimation I used the *margins* command in Stata to calculate the marginal effect of residential relocation on the probability of reincarceration.

RESULTS

Results presented in Figure 2 show that those individuals who moved to a different parish from where they resided in the past were significantly and substantially *less* likely to be reincarcerated (see Table S1 in the Appendix for the full table of results). The probability of reincarceration is 0.10 lower for individuals who did not move back to the parish where they were originally convicted relative to individuals who did ($p = 0.019$). The 95 percent confidence interval of the marginal effect ranges from -0.191 to -0.017. An estimated 10 percent of parolees who moved were reincarcerated within one year of their release from prison versus 20 percent of stayers.

[FIGURE 2 HERE]

It is pertinent to consider whether the apparent effect of residential relocation on reincarceration depends upon whether individuals have received recent treatment for their substance abuse. On the one hand, it could be the case that individuals with an addiction who have not recently participated in treatment are not yet cognitively ready to take advantage of a fresh start in a new physical and social environment. If they have not had behavioral treatment as a platform for changing their “criminal thinking” or accepting personal responsibility for their behavior, then a new environment may do little to alter prior patterns of behavior. Conversely, precisely because treatment prepares individuals for addressing and managing their disease of addiction, individuals who have not had the aid of drug treatment may actually benefit the most from residential relocation.

For the analysis presented in Figure 3, I subset the sample to compare drug dependent individuals who completed recommended treatment during incarceration or for which treatment was deemed unnecessary versus individuals who needed treatment but either were unsuccessfully terminated from treatment or were unable to participate because of a lack of institutional capacity. Among the first group, the probability of reincarceration is 0.09 lower for individuals who did not move back to the parish where they were originally convicted relative to individuals who did ($p = 0.097$), with a 95 percent confidence interval ranging from -0.190 to

0.016. Among individuals who did not complete a necessary treatment program, the probability of reincarceration is 0.22 lower for individuals who did not move back to the parish where they were originally convicted relative to individuals who did ($p = 0.083$), with a 95 percent confidence interval ranging from -0.470 to 0.029. Whereas these confidence intervals for the marginal effects are overlapping, there is at least some suggestive evidence that individuals in need of treatment who did not get it may actually benefit the most from residential relocation.

[FIGURE 3 HERE]

DISCUSSION

Using Hurricane Katrina as an exogenous source of variation that fundamentally influenced where exiting prisoners resided in the period right after the hurricane, in this study I was able to more thoroughly resolve the issue of selection bias than many prior studies of the effects of residential relocation. IV analysis revealed that the probability of reincarceration is 0.10 lower for individuals who relocated to a new parish upon their exit from prison relative to where they lived prior to incarceration. This finding is consistent with prior research on the effects of residential relocation among drug users and prisoners more generally [8, 13 – 19].

An important avenue for future research would be to investigate the effect of residential relocation for drug-related behavior in a true randomized experimental design in order to provide an even more rigorous test of the effects of residential relocation. This could be done through an experimental housing mobility program, with the control group receiving subsidized housing back in a home county and a treatment group receiving subsidized housing in a different county. There is already some precedent for such an intervention [24, 25].

In summary, the aim of this study has been to determine if residential relocation to a different county by drug dependent former prisoners lowers their likelihood of reincarceration. To the extent that the results can be validated in further research, programs and policies that provide greater access to housing assistance for individuals with a history of substance abuse, particularly housing opportunities located far away from former neighborhoods, may yield substantial individual-level and societal benefits in terms of reductions in overdoses, lower crime rates, and fewer tax dollars spent on emergency room visits, jails, and prisons.

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FIGURES AND TABLES

Figure 1. The Percent of Louisiana Parolees who Moved to a Different Parish upon Release from Prison, Pre- versus Post-Katrina

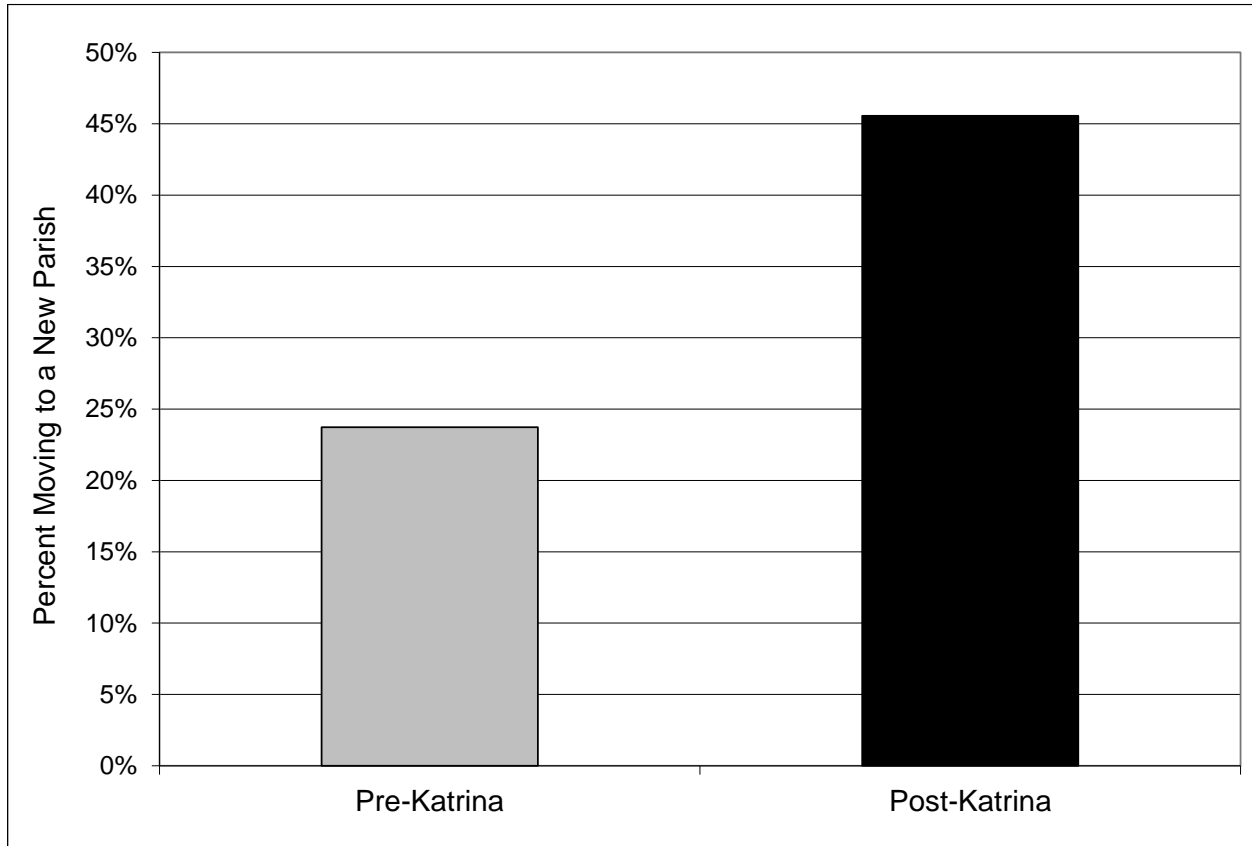


Figure 2. The Predicted Probability of Reincarceration within One Year of Release, Stayers vs. Movers

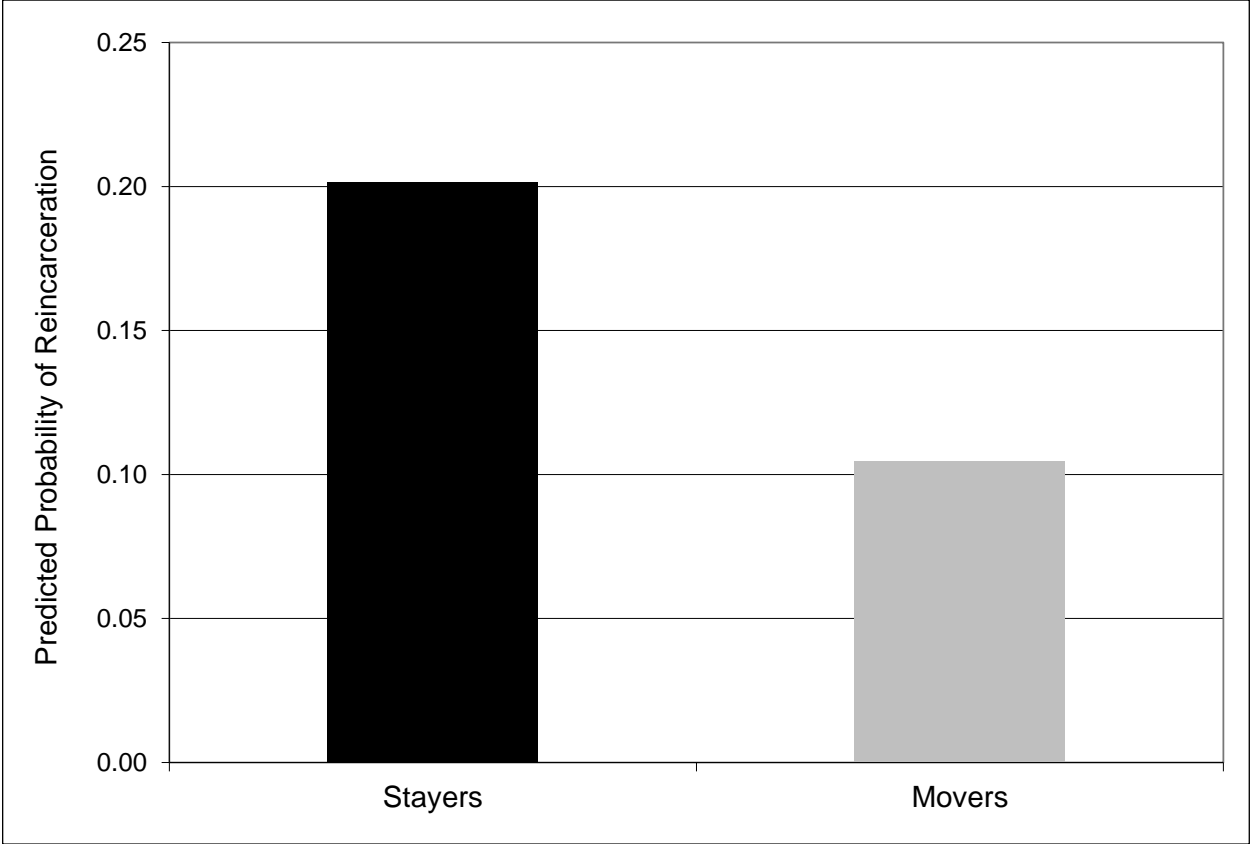


Figure 3. The Predicted Probability of Reincarceration within One Year of Release, Stayers vs. Movers by Drug Treatment Status while Incarcerated

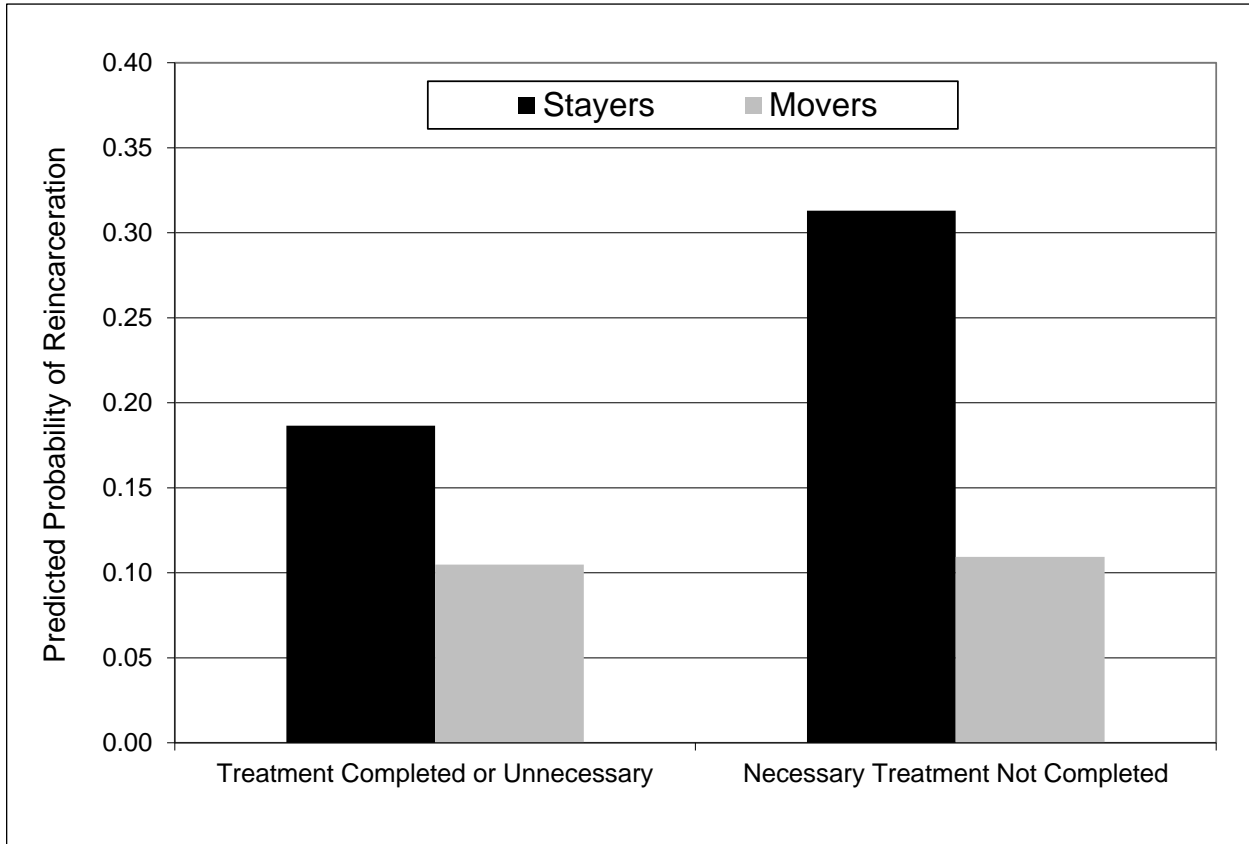


Table S1. Instrumental Variable Probit Estimates of Re-Incarceration

	Coef.	Robust Std. Err.	
Residential Relocation	-0.420	(0.180)	*
Individual-Level			
Black	-0.087	(0.095)	
Male	-0.113	(0.116)	
Married	-0.218	(0.205)	
Age at Release	-0.004	(0.003)	
Time Served	-0.035	(0.020)	
First Release	-0.130	(0.079)	
LARNA Risk Score	0.079	(0.012)	***
Context and Crim. Justice System			
Jefferson Parish	-0.326	(0.111)	**
Plaquemines Parish	-0.616	(0.274)	*
St. Bernard Parish	-0.106	(0.127)	
St. Tammany Parish	-0.316	(0.100)	**
Socioeconomic Conditions	-0.100	(0.026)	***
Criminal Justice Operations	-0.022	(0.027)	
Intercept	-0.952	(0.271)	***

Notes: $N = 1464$; * $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$

Table S2. IV Probit Estimates of Re-Incarceration, by Drug Treatment Status

	Completed Treatment or Treatment Unnecessary		Treatment Terminated or Unable to Attend	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Residential Relocation	-0.364	(0.223)	-0.743	(0.420)
Individual-Level				
Black	-0.108	(0.075)	0.070	(0.280)
Male	-0.154	(0.168)	0.142	(0.374)
Married	-0.266	(0.205)	0.050	(0.536)
Age at Release	-0.003	(0.002)	-0.010	(0.013)
Time Served	-0.038	(0.020)	-0.034	(0.023)
First Release	-0.096	(0.085)	-0.306	(0.265)
LARNA Risk Score	0.087	(0.014) ***	0.083	(0.033) *
Context and Crim. Justice System				
Jefferson Parish	-0.393	(0.089) ***	0.024	(0.452)
Plaquemines Parish	-0.442	(0.365)	(omitted)	
St. Bernard Parish	-0.119	(0.131)	0.118	(0.409)
St. Tammany Parish	-0.403	(0.110) ***	0.173	(0.360)
Socioeconomic Conditions	-0.119	(0.035) ***	-0.007	(0.114)
Criminal Justice Operations	-0.034	(0.025)	0.080	(0.166)
Intercept	-0.976	(0.350) **	-1.239	(0.839)
<i>N</i>	1274		183	

Notes: All observations from Plaquemines Parish (seven) in the right column analysis were dropped from the analysis because of a lack of variation. All seven cases had the same value for the dependent variable.

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

APPENDIX

CASES

As described in the main text, the sample includes parolees with a history of drug abuse who were originally committed to prison from Orleans Parish or the four parishes adjacent to Orleans which make-up the wider New Orleans metropolitan area (Jefferson, Plaquemines, St. Bernard, and St. Tammany). The pre-Katrina cohort is comprised of individuals released from Louisiana prisons from September 2003 to February 2004 who had a history of drug abuse ($N = 788$). The post-Katrina cohort is comprised of releases from a Louisiana prison immediately after the hurricane, from September 2005 to February 2006 ($N = 676$).

MEASURES

This study draws upon prison release and re-incarceration data from the Louisiana Department of Public Safety and Corrections (DPS&C) to estimate the effect of residential relocation among drug dependent former prisoners on the likelihood of reincarceration.

Statistical analyses presented in the main body of the paper control for a variety of (1) individual characteristics, (2) socioeconomic conditions, and (3) the operation of the criminal justice system. Analyses include seven individual-level control variables designed to account for potential differences in prison releases pre/post Katrina: race, gender, marital status, age at time of release, time served in prison, incarceration history, and LARNA risk score.

I measure parolee race with a binary variable (black equals one, otherwise zero). Black parolees compose 71.7 percent of the sample, with whites making up 28.3 percent. Males compose 87 percent of the sample, and nine percent of the sample were married at the time of release. On average, prisoners were 33 years old at the time of release. Averaged time served is two years, which partly reflects the fact that some individuals were serving time on shorter duration parole revocations. Controlling for time served is necessary to account for any differences between cohorts in the average severity of prior offending. I measure incarceration history as a binary variable labeled “first release” which indicates whether the parolee was released from his or her first term of incarceration (equals one) or from a second or greater term (zero). The Louisiana Risk/Needs Assessment (LARNA) risk score is based on a risk assessment completed within two months after an individual is released from prison onto parole supervision, and includes a total of 12 items measuring static and dynamic predictors of criminal recidivism including a history of drug abuse, criminal history, a history of mental health problems, and current and past employment. Based on information from the individual LARNA item related to recent drug treatment (question 11 of the assessment), for the Figure 3 and Table S2 analysis I split the sample into individuals for which treatment was deemed unnecessary or necessary and successfully completed versus those individuals who were unsuccessfully terminated from treatment or were unable to attend a necessary treatment program (e.g., because of a lack of available spots).

For the purposes of estimating the effect of residential relocation on reincarceration net of the socioeconomic conditions of destination parishes, I include the following statistical controls related to socioeconomic conditions, all measured at the parish level at the time point in which a

given parolee was released from prison: segregation, income inequality, the unemployment rate, average weekly wages, and fair market rents. Measures of segregation (dissimilarity) and income inequality are drawn from annual sociodemographic estimates produced by ESRI [21]. I use 2004 estimates for the pre-Katrina cohort and 2006 estimates for the post-Katrina cohort. Data on unemployment and wages comes from the Louisiana Department of Labor, and are measured during the calendar-quarter in which the parolee was released from prison. From data compiled by the U.S. Department of Housing and Urban Development, I use estimates of fair market rents in 2004 for the pre-Katrina cohort and in 2006 for the post-Katrina cohort. Figures are adjusted to 2000 dollars. Because of sizable correlations between these various aspects of socioeconomic context, I combined these five measures into one variable (*socioeconomic status*) through principal components analysis.

The implications of Hurricane Katrina for changes in the criminal justice system in Louisiana are many [26, 27]. For instance, because of the depopulation of New Orleans and the geographic shift in where parolees fresh out of prison resided after Katrina, there was an increase in the ratio of parole officers to parolees in New Orleans [28, 29]. Arguably then, parolees in New Orleans after Katrina faced greater scrutiny than their pre-Katrina counterparts. Given that increased scrutiny is associated with higher recidivism rates [30], the increased ratio of parole officers to parolees post-Katrina may have resulted in higher levels of reincarceration. Therefore, using parish-level data from the Supreme Court of Louisiana, the Uniform Crime Reports (UCR), the DPS&C, and the Division of Probation and Parole, I developed pre- and post-Katrina measures of judge caseloads (in 2004 and 2006 for the pre- and post-Katrina cohorts, respectively), the likelihood of arrest following the commission of a crime (UCR arrests divided by reported crimes, based on 2003 and 2005 data for the respective cohorts), average parole contacts per parole officer during the quarter in which a parolee was released from prison, and the reincarceration rate in the parolee's parole district during the 6 months prior to when he or she was released from prison. I combined these measures via principal components analysis and labeled the component *criminal justice operations*.

Finally, I also included binary variables representing the origin parish of respondents, with Orleans parish omitted as the reference category.

RESULTS

Figures 2 and 3 in the main body of the paper were produced based on marginal effects from the estimated results found in Tables S1 and S2 respectively. These models were estimated with an instrumental variables probit model, via the *ivprobit* command in Stata. This command estimates two structural equations as part of the two-stage estimation process with the IV technique. The first equation models the treatment variable — residential relocation — as a function of an instrumental variable which represents the release cohort (i.e., released pre-Katrina or released post-Katrina) and a vector of control variables as described above. The second-stage of the two-stage estimation process models the dependent variable, reincarceration within one-year of release, as a function of the predicted treatment variable (residential relocation) from the first equation. Postestimation I used the *margins* command in Stata to calculate the marginal effect of residential relocation on the probability of reincarceration.

I used a binary treatment variable in this study — residential relocation equaled one if an individual moved to a different parish upon release from prison relative to where she or he resided prior to incarceration, and it equaled zero if she or he moved back to the same parish upon release. With a binary treatment variable, marginal effects measure a discrete change — that is, how predicted probabilities change as the binary variable changes from zero to one. In a probit model, the marginal effect of a binary variable is computed by:

$$\varphi(x\beta) * \beta_k$$

where φ is the probability density function for a standardized normal variable [31].

[TABLES S1 AND S2 HERE]