**APPENDIX**

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# **eAppendix A: Dates of Re-openings and Non-Pharmaceutical Interventions**

## eFigure A1. City and State Re-openings and Rolling 7-Day Average Case Rates



Grey vertical line indicates date when cities closed dining, black vertical line indicates date when state allowed reopening or required re-opening (in comparison cities), red vertical line indicates actual city re-opening in treatment cities (i.e. cities that were allowed to keep indoor dining closed).

## eTable A2. City and State Re-opening Indoor Dining Dates

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **City and State NPIs-Reopening Indoor Dining and Resuming In-Person Classes** | | | | | |
| **Group** | **State** | **City** | **County** | **Indoor Dining Reopen Date-State/Allowed by State** | **Indoor Dining Reopen Date-City** |
| Treatment | California | San Franciscoa | San Francisco | 8/31/2020 | 9/30/2020 |
| Treatment | Indiana | Indianapolisa | Marion | 5/11/2020 | 6/1/2020 |
| Treatment | Pennsylvania | Philadelphiaa | Philadelphia | 6/26/2020 | 9/8/2020 |
| Treatment | Wisconsin | Milwaukeea | Milwaukee | 5/14/2020 | 6/5/2020 |
| Comparison | Arizona | Phoenix | Maricopa | 5/11/2020 | 5/11/2020 |
| Comparison | Georgia | Atlanta | Fulton | 4/27/2020 | 4/27/2020 |
| Comparison | South Carolina | Charlestona | Charleston | 5/11/2020 | 5/11/2020 |
| Comparison | Texas | Austin | Travis | 5/1/2020 | 5/1/2020 |
| Comparison | Texas | Dallas | Dallas | 5/1/2020 | 5/1/2020 |
| Comparison | Texas | Houston a | Harris | 5/1/2020 | 5/1/2020 |
| Comparison | Texas | San Antonioa | Bexar | 5/1/2020 | 5/1/2020 |

We collected information on statewide and city/county indoor dining orders by searching multiple publicly available databases, and state/city website listing these orders and reviewing state/city orders issued between April 1 and September 30. Our search includes city, county, or state orders signed by Governors, Mayors, or judges. a indicates cities that share contiguous boundaries with the county

## eTable A3: Dates of City and State Non-Pharmaceutical Interventions

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | **City and State NPIs-Stay-At-Home Orders, Mask Mandates, & Eviction Moratoriums** | | | | | | | |  |
| **Group** | | **State** | **City** | | **Date City Closed Indoor Dining** | **Date of State Stay-at-home Order Lifted** | **Date of City Stay-at home Order Lifted** | **Date of State Mask Mandate** | **Date of City Mask Mandate** | **State Eviction Moratorium Dates** | **City Eviction Moratorium Dates** | **Public Schools Resume In-Person Classes-City** |
| Treatment | | California | San Francisco | | 3/17/2020 | 5/14/2020 | 5/14/2020 | 6/18/2020 | 4/17/2020 | 3/1/2020 -6/30/2021 | 3/1/20-  6/30/21 | Did not resume in-person classes |
| Treatment | | Indiana | Indianapolis | | 3/23/2020 | 5/1/2020 | 5/18/2020 | 7/27/2020 | 7/9/2020 | 3/19/2020-8/14/2020 | Same as state | Did not resume in-person classes |
| Treatment | | Pennsylvania | Philadelphia | | 3/23/2020 | 6/5/2020 | 6/5/2020 | 7/1/2020 | N/A | 5/7/2020-8/31/2020 | 3/18/2020-12/31/2020 | Did not resume in-person classes |
| Treatment | | Wisconsin | Milwaukee | | 3/26/2020 | 5/13/2020 | 6/5/20 | 8/1/2020 | 5/14/2020 | 3/27/2020-5/27/2020 | Same as state | Did not resume in-person classes |
| Comparison | | Arizona | Phoenix | | 3/31/2020 | 5/16/2020 | 5/16/20 | No mandatea | 6/20/2020 | 3/24/2020-10/31/2020 | Same as state | Did not resume in-person classes |
| Comparison | | Georgia | Atlanta | | 3/24/2020 | 5/1/2020 | 5/1/20 | No mandate | 7/8/2020 | N/A | 3/16/2020-10/31/2020 | Did not resume in-person classes |
| Comparison | | South Carolina | Charleston | | 3/27/2020 | 5/4/2020 | 5/31/20 | No mandatea | 7/1/2020 | 3/17/2020-5/15/2020 | Same as state | 9/8/2020 |
| Comparison | | Texas | Austin | | 3/24/2020 | 5/1/2020 | 7/15/20 | 7/3/2020 | 6/22/20 | 3/19/2020-5/19/2020 | 3/19/2020-12/31/2020 | 10/5/2020 |
| Comparison | | Texas | Dallas | | 3/22/2020 | 5/1/2020 | 5/15/20 | 7/3/2020 | 6/19/2020 | 3/19/2020-5/19/2020 | Same as state | 9/28/2020 |
| Comparison | | Texas | Houston | | 3/24/2020 | 5/1/2020 | 5/20/20 | 7/3/2020 | 4/22/2020 | 3/19/2020-5/19/2020 | Same as state | 10/19/2020 |
| Comparison | | Texas | San Antonio | | 3/24/2020 | 5/1/2020 | 6/5/20 | 7/3/2020 | 6/17/2020 | 3/19/2020-5/19/2020 | 3/19/2020-6/1/2020 | 9/8/2020 |

We collected information on statewide and city/county orders from searching multiple publicly available databases, and state/city websites listing these orders and reviewing state/city order. aMasks mandated for certain businesses, no broad state-wide mask mandate.

# **eAppendix B: Counterfactual Assumption & Re-Opening Citations**

## eTable B2: Citations for Counterfactual Assumption that Cities Would Have Kept Indoor Dining Closed if Not Preempted, Comparison Cities

|  |  |  |  |
| --- | --- | --- | --- |
| **Evidence of Preemption** | | | |
| **City** | **State** | **Preempted City Policy** | **State Preemption** |
| **Phoenix** | **Arizona** | [Mayor Gallego Tweet](https://twitter.com/MayorGallego/status/1281338056058867714)  [Mayor Gallego Statement On Stay-at-Home Order](https://www.phoenix.gov/newsroom/mayors-office/1151) | [Arizona Executive Order](https://azgovernor.gov/sites/default/files/eo_2021_0.pdf) |
| **Austin** | **Texas** | [Interview with Mayor Adler](https://www.nbcnews.com/news/us-news/some-texas-cities-nervous-governor-reopens-state-everybody-scared-n1198691)  [April 13, 2020 Executive Order](https://www.austintexas.gov/sites/default/files/files/document_96DEBEEC-E581-05E0-8A3D444404948A84.pdf)  [May 8, 2020 Executive Order](https://www.austintexas.gov/sites/default/files/files/Order%2020200508-011.pdf) | [Texas Executive Order](https://gov.texas.gov/news/post/governor-abbott-issues-executive-order-relating-to-the-expanded-reopening-of-services) |
| **Dallas** | **Texas** | [Letter to Honorable Clay Jenkins of Dallas County](https://www.texasattorneygeneral.gov/sites/default/files/images/admin/2020/Press/Dallas%20County%20Letter_05122020.pdf?)  [Dallas County April 23, 2020 Executive Order](https://www.dallascounty.org/Assets/uploads/docs/covid-19/orders-media/2020/april/042320-DallasCountyOrder.pdf)  [Dallas County May 4, 2020 Executive Order](https://www.dallascounty.org/Assets/uploads/docs/covid-19/orders-media/2020/may/050120-Supplemental-DallasCountyOrderonReopenedServices.pdf) |
| **San Antonio** | **Texas** | [Texas City and County Leaders ask Gov Greg Abbott for authority to implement local stay-at-home orders](https://www.texastribune.org/2020/06/29/texas-coronavirus-stay-at-home-harris-dallas/)  [Executive Order NW-05 OF County Judge Nelson W. Wolff, Issued April 6, 2020 (bexar.org)](https://www.bexar.org/DocumentCenter/View/26538/Executive-Order-NW-05-April-6-2020?bidId=)  [Executive Order NW-07 OF County Judge Nelson W. Wolff Issued April 29, 2020 (bexar.org)](https://www.bexar.org/DocumentCenter/View/26838/Executive-Order-NW-07-Issues-April-29?bidId=) |
| **Houston** | **Texas** | [Mayor Turner's letter to Governor Abbott](https://www.chron.com/file/650/7/6507-6.30.2020%20MST%20to%20Abbott.pdf)  [Harris County April 4, 2020 Executive Order](https://agenda.harriscountytx.gov/2020/AmendedStayHomeOrder.pdf)  [Harris County May 1, 2020 Executive Order](https://agenda.harriscountytx.gov/2020/20200501Order.pdf) |
| **Atlanta** | **Georgia** | [Atlanta Isn't Ready to Reopen-And Neither is Georgia-Keisha Lance Bottoms in The Atlantic](https://www.theatlantic.com/ideas/archive/2020/04/its-too-early-to-reopen-georgia/610909/) | [2020 Executive Orders | Governor Brian P. Kemp Office of the Governor (georgia.gov)](https://gov.georgia.gov/executive-action/executive-orders/2020-executive-orders) (See Executive Order 7/15/20 Pg 32) |
| **Charleston** | **South Carolina** | [2020-070-Emergency-Ordinance---Stay-at-Home (charleston-sc.gov)](https://www.charleston-sc.gov/DocumentCenter/View/27264/2020-070-Emergency-Ordinance---Stay-at-Home) | [2020-05-08 FILED Executive Order No. 2020-34 - Authorization of Limited Indoor Dining Services & Rescission of Boating Restrictions.pdf](https://governor.sc.gov/sites/default/files/Documents/Executive-Orders/2020-05-08%20FILED%20Executive%20Order%20No.%202020-34%20-%20Authorization%20of%20Limited%20Indoor%20Dining%20Services%20%26%20Rescission%20of%20Boating%20Restrictions.pdf) |

We collected information on statewide and city/county orders from searching multiple publicly available databases, and state/city websites listing these orders and reviewing state/city orders. We identified public statements by searching news articles, twitter posts, and state/city websites.

## eTable B3: Information and Evidence for City and State Indoor Dining Reopening Orders, Treatment Cities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Opening Date References for Treatment Cities** | | | | |
| **City** | **State** | **Detail** | **City Evidence** | **State Evidence** |
| **Indianapolis** | **Indiana** | Governor Holcomb permitted indoor dining to resume throughout Indiana on 5/11/2020. Indianapolis waited until 6/1/2020 to resume indoor dining despite being eligible to reopen indoor dining on 5/11. | [Mayor Joe Hogsett Statement on Reopening Indianapolis](https://citybase-cms-prod.s3.amazonaws.com/455ab1988f7f491684889f6200d1ce1e.pdf) | [Back On Track Indiana: Governor Holcomb's Indiana COVID-19 Update (May 1, 2020)](https://www.backontrack.in.gov/2362.htm) |
| **Philadelphia** | **Pennsylvania** | PA permitted Philadelphia County to resume indoor dining on 6/26/2020 when the city entered the green phase. Philadelphia waited until 7/3/2020 to enter the green phase for most activities, but the city waited until 9/8/2020 to resume indoor dining. | [What the green phase means for Philadelphia | Department of Public Health | City of Philadelphia](https://www.phila.gov/2020-06-18-what-the-green-phase-means-for-philadelphia/#:~:text=When%20Philadelphia%20enters%20the%20green,.%20Schools%20and%20colleges.)  [Philadelphia to Reopen Indoor Dining Sept 8, 2020](https://www.phila.gov/2020-08-20-indoor-dining-is-back-on-september-8-in-philadelphia/#:~:text=Indoor%20dining%20is%20back%20in,while%20gradually%20and%20safely%20reopening) | [Gov. Wolf: 12 More Counties to Go Green on June 26 (pa.gov)](https://www.governor.pa.gov/newsroom/gov-wolf-12-more-counties-to-go-green-on-june-26/)  [Process to Reopen Pennsylvania (pa.gov)](https://www.governor.pa.gov/process-to-reopen-pennsylvania/) |
| **San Francisco** | **California** | Governor Newsom issued county guidance preempting counties from enacting less restrictive policies than those directed by the state's mandate. While the city of San Francisco met statewide guidelines (red phase) for re-opening indoor dining on 8/28, the city chose to keep indoor dining closed. On 9/30 the city issued guidance allowing indoor dining at 25%. | [San Francisco to Move Forward with Reopening More Businesses and Activities on September 30 | Office of the Mayor (sfmayor.org)](https://sfmayor.org/article/san-francisco-move-forward-reopening-more-businesses-and-activities-september-30) | [Safely reopening California - Coronavirus COVID-19 Response](https://covid19.ca.gov/safely-reopening/#reopening-california)  [Dashboard for County Phases, as of August 28, 2020](https://sfist.com/2020/08/28/newsom-new-color-codes-covid-county-watch-list/) |
| **Milwaukee** | **Wisconsin** | Wisconsin’s Safer At Home order went into effect on March 25, 2020, it prohibited nonessential travel and limited gatherings.  On April 20th the governor issued the "Badger Bounce Back" plan to continue the emergency order and determine phased re-opening plans. On May 13th the Wisconsin state supreme court struck down the executive order. On May 14th Milwaukee issued their own order, and though allowed by the state to open up as of 5/14, did not re-open indoor dining until 6/5. | [Milwaukee May 14 Order](https://www.documentcloud.org/documents/6890535-Moving-Milwaukee-Forward.html)  [Milwaukee Phase 3 Order](https://city.milwaukee.gov/MMFSReleasePh3)  [Milwaukee Phase 4 Order](https://city.milwaukee.gov/ImageLibrary/MKE-Health1/MMFSReleasePh4_6.26.20.pdf) | [Wisconsin Safer at Home Order](https://content.govdelivery.com/accounts/WIGOV/bulletins/282deef)  [Wisconsin Supreme Court Strikes Down Stay-at-Home Order](https://www.nytimes.com/2020/05/13/us/coronavirus-wisconsin-supreme-court.html) |

We collected information on statewide and city/county orders from searching multiple publicly available databases, and state/city websites listing these orders and reviewing state/city orders. We identified public statements by searching news articles, twitter posts, and state/city websites.

# **eAppendix C: Model Specification**

## eAppendix C1: Model Specification and Description

The canonical DID model specification is as follows:

Where we model the daily count of cases in each *j*th city on the *i*th day. For the treatment group the dummy variable *Post* is coded as 1 for days beginning 14 days post time-zero (with time-zero being the day the state reopened but the city remained closed), and 0 otherwise. For the comparison group, the variable Post is coded as 1 for days beginning 14 days post time-zero (with time zero being the date the city re-opened indoor dining because it was preempted by the state), and 0 otherwise. The *Dining Closed* dummy variable is 1 in treatment cities (that kept indoor dining closed) and 0 in comparison cities (that attempted to keep indoor dining from opening but were preempted from doing so). Our main coefficient of interest is : by exponentiating we obtain the incidence rate ratio representing the association between keeping indoor dining closed compared with re-opening indoor dining. represents other time-varying local mitigation & reopening policies that may act as potential confounders: stay at home orders, mask mandates, and city/state eviction bans, with a 14-day lag from the date of policy implementation. We use a negative binomial model, with city population as the offset and with Huber-White robust standard errors clustered at the city and state level. While clustered standard errors may bias standard errors down with small numbers of units in DiD analysis, we opt for robust standard errors clustered at the city and state levels because of challenges with model convergence using suggested alternatives (e.g. wild bootstrap1) with population offsets.

We also employ an event study specification to examine whether the effects of re-opening indoor dining differ in the weeks following re-opening. The event-study specification has been used recently to examine the effect of eviction moratoriums and mask mandates, and on-premise dining on COVID-19 incidence2-4. We estimated the impact of re-opening, rather than keeping indoor dining closed as the treatment, because we expected a change in trend after re-opening. Though the model allows for estimation of changing growth rates by week, it does not take advantage of our counterfactual comparison group, because it uses the date of re-opening for all cities, rather than comparing cities that re-opened to those that remained closed, so may be subject to additional selection bias.

We estimate the following model, using city-level daily data:

We measured associations between the re-opening and COVID-19 case rates using a reference period (1 week before re-opening 2) compared with 11 mutually exclusive weeks relative to implementation (4 weeks before, 8 weeks after). The coefficients on the post weeks represent the impact of re-opening indoor dining during each of those post re-opening weeks, compared to the week before re-opening. We expect no associations in the first weeks following treatment because of lags between policy implementation and COVID-19 growth, and expect the associations to grow over time if there is increasing use of indoor dining and if indoor dining increases infection risk. The pre-week variables capture differences in pre-reopening COVID-19 trends before cities re-opened indoor dining; differences would suggest that trends were already diverging before policies went into place.

To control for the time-varying impacts of other NPIs, we added to the model, representing other time-varying local mitigation & reopening policies that may act as potential confounders: stay-at-home orders, mask mandates, and city/state eviction bans, with a 14-day lag from date of policy implementation. These are included as ordinal variables (instead of binary ones), using the count of weeks since the NPI was implemented (1-5, with >4 weeks after implementation coded as 5). If a city never enacted the policy, or enacted the policy outside of the study period, we code the variable as zero for all observations. Finally, we add a control for calendar date, to control for any secular time trends in the mean outcome5, and applied an unconditional fixed effect negative binomial approach using city dummies6 to control for time-invariant between city factors. We tested extending the study period to 12 weeks after re-opening (alternative specification 1), and to setting the NPI confouders as ordinal variables without the 4+ week limitation (i.e. NPI ordinal variables can go above 5 after 5 weeks post implementation; alternative specification 2).

# **eAppendix D: Robustness Checks**

## eAppendix D1: Description of sensitivity analysis

As detailed in the main manuscript, we conducted six sets of sensitivity analyses to test for robustness of our model to alternative specifications: we: (1) included a city-fixed effect, ran a two-way fixed effects (TWFE) DiD specification (city and calendar week fixed effects), and added a state-fixed effect to our main model, (2) extended the duration of follow-up to 12 weeks and varied the pre-specified 2-week lag, (3) excluded various cities, controlled for weeks of closure prior to the treatment, and controlled for potential demographic and protective behavioral differences between treatment and comparison cities (racial/ethnic composition, public transit use, and mask wearing), and (4) repeated the analysis using death rates instead of case rates, (5) ran a linear model with log case rates and wild bootstraps, and (6) we explored an alternative modeling approach for staggered policy adoption and treatment heterogeneity using the Callaway and Sant’Anna approach7.

First, we included city fixed effects in our main model to control for time in-variant between city factors. We then implement an alternative specification of our main DID model, treating the model as a multi-group multi-period DiD (two-way fixed effects or TWFE), and controlling for city and calendar time fixed effects. The model specification is as follows: Where we model the daily count of cases in each *j*th city on the *i*th day. The policy indicator is time-varying and coded as 0 for all cities in the pre period and then changes to 1 for treated cities, beginning 14 days post time-zero (with time-zero being the day the state reopened but the city remained closed). Our main coefficient of interest is: by exponentiating we obtain the incidence rate ratio representing the association between keeping indoor dining closed compared with re-opening indoor dining. are city-level fixed effects and are calendar week time fixed effects; we include city fixed effects to control for time-invariant between city factors and we include calendar week fixed effects to control for any time varying between city seasonal or disease dynamic effects. is a vector of time-varying city-level confounders. Other aspects of the model are the same as the main model. We additionally tested adding state fixed effects to our main model.

Second, the main canonical DID analysis includes a 6-week (2-week lag + 4-weeks post lag) follow-up period, and we tested extending the study period to 24 weeks (12 pre and post). Our main analysis also uses a 2-week lag to account for delays from infection to case reporting, and we considered alternative lag periods of 9-days, 3-weeks, and 4-weeks.

Third, we limited our analysis to only the cities in the BCHC, to test if city selection impacts estimated impacts. We additionally tested removing San Francisco (state allowed the city to open 8/31) from the analysis, to test if patterns of declined cases after delaying re-opening were explained by seasonal differences. We additionally controlled for weeks of closure prior to the treatment, and controlled for potential demographic and behavioral differences between treatment and comparison cities that may bias the relationship between indoor dining and COVID-19 rates. We only include a small number of variables, given the limited sample size of our study. We include two variables with slightly different median sociodemographic characteristics (racial/ethnic composition and public transit use), and our available measure of a COVID-19 behavioral mitigation behavior (mask wearing).

Fourth, we repeated our main analysis but included death rates as our outcome rather than case rates. We include the deaths analysis because case counts may differ across cities over time due to differential testing intensity and availability. Death counts are more robust to testing bias, so substantively similar results in the deaths analysis strengthens the validity of our case analysis. We considered a main analysis with a 5-week lag (2-week case + 3-week lag after cases). We limit this analysis to the week after through the 9 weeks after re-opening (“time-zero”). The pre-treatment period includes outcomes in the week after through 5 weeks after “time-zero” which represent the four weeks before “time zero” with the five-week lag. We limit the deaths model to the main adjusted analysis (adjusted for NPIs), using city population as an offset, and robust standard errors clustered at the city and state level.

Fifth, given the small number of clusters (cities) our robust clustered standard errors may be biased, suggesting a wild bootstrap approach may provide a more valid estimation of standard errors8. However, wild bootstraps cannot be implemented with generalized linear models9, so we conduct a sensitivity analysis using a linear model of log case rates, with wild cluster bootstrap using Rademacher weights, excluding days with zero counts (as their log rate is undefined), all implemented using the fwildclusterboot R package. This approach addresses the potential bias in the variance due to the small numbers of clusters but changes the modeling approach from the adequate count (negative binomial) model, to a linear model of log(rates), that fails to take into consideration the added (decreased) precision of higher (lower) case counts.

Sixth and last, recent econometric developments offer a number of challenges and solutions to potential biases in the interpretation of parameters associated with TWFE estimation in the presence of staggered treatment timing, multiple time periods, and heterogeneous treatment effects 7,10-12. To address potential biases that may arise from inappropriate specification of the canonical DID model, we include a sensitivity model using the Callaway and Sant’Anna (2020) approach, which allows for flexible incorporation of pre-trend variables (using doubly robust methods), allows robust estimation of CI’s, and allows estimation of group (or cohort) specific ATT’s, as well as methods for aggregating group specific ATT’s into an overall ATT7.

Using the Callaway and Sant’Anna approach, we invert the treatment and comparison group, because the methods require a change in state for the treatment group; so treatment now becomes re-opening dining (cities that were preempted and forced to re-open), and comparison cities are those that remained closed (our “never treated” group). We create two treatment cohorts: one cohort combining cities that re-opened on 4/27 and cities that that re-opened on 5/1, and another cohort including cities that re-opened on 5/11. We also create 3 periods; following Callaway and Sant’Anna’s suggested approach, our periods align with the treatment dates and include the two-week lag after re-opening. We assume that the treatment stays treated (achieved through limiting the study period), and that there is no anticipation, an assumption supported by state preemption which did not allow treatment cities to “choose” treatment status, and that there are conditional parallel trends. The limited staggering of treatment suggests that variation in treatment timing may not provide a substantive source of bias in our analysis. We provide the unadjusted estimator because our adjusted main analysis includes time-varying covariates, while the Callaway and Sant’Anna approach adjusts for pre-treatment variables. We do not employ the doubly robust estimation approach because of limited variation in pre-treatment variables given our relatively small number of cities, which does not allow for variable overlap without transforming pre-treatment variables and introducing additional imprecision in the propensity score. We also do not include the group-specific Average Treatment on the Treated (ATT) estimates because our groups are small leading to unstable group specific ATT estimates, and instead show only the summary parameters. We include aggregated summary treatment effect parameters in two ways: using the simple weighted average (weights proportional to the group size) and average weighted by different lengths of exposure to the treatment, both estimated using the R did package13. Qualitatively different results using the Callaway and Sant’Anna estimator would suggest that the TWFE and two-group two-period approach are not robust to treatment heterogeneity and staggered treatment timing. Please note that the coefficients we report have been inverted (1/ overall ATT) to allow for comparability with the main analyses. Importantly, this analysis was conducted using a linear model with log(rates), instead of the negative binomial model we used for the other analyses, since the software implementation of this approach has not been developed for generalized linear models.

## eTable D2: Event Study Adjusted Incidence Rate Ratios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Alternative Specifications** | | | |
|  | **Main Model** | **1** | **2** | **3** | **4** |
| **Weeks since lifted** | **IRR(CI)** | **IRR(CI)** | **IRR(CI)** | **IRR(CI)** | **IRR(CI)** |
| -4 | 0.68  (0.41, 1.11) | 0.60  (0.35, 1.03) | 0.63  (0.82, 1.21) | 0.69  (0.38, 1.22) | 0.82  (0.42, 1.61) |
| -3 | 0.91  (0.55, 1.50) | 0.88  (0.52, 1.49) | 0.85  (0.48, 1.50) | 0.93  (0.56, 1.54) | 0.88  (0.58, 1.32) |
| -2 | 1.02  (0.87, 1.19) | 1.02  (0.87, 1.18) | 1.0 (0.82, 1.20) | 1.03  (0.88, 1.20) | 1.02  (0.88, 1.2) |
| -1 | Ref | Ref | Ref | Ref | Ref |
| 1 | 1.28  (0.92, 1.79) | 1.24  (0.91, 1.67) | 1.38  (0.95, 2.0) | 1.27  (0.97, 1.64) | 1.28  (0.99, 1.16) |
| 2 | 1.25  (0.69, 2.24) | 1.21  (0.71, 2.06) | 1.38  (0.72, 2.63) | 1.20  (0.66, 2.17) | 1.16  (0.64, 2.08) |
| 3 | 1.30  (0.49, 3.43) | 1.14  (0.46, 2.82) | 1.58  (0.74, 3.37) | 1.21  (0.46, 3.13) | 1.34  (0.58, 3.11) |
| 4 | 1.63  (0.44, 6.00) | 1.35  (0.38, 4.80) | 1.95  (0.69, 5.51) | 1.41  (0.38, 5.19) | 1.46  (0.42 5.10) |
| 5 | 3.22  (0.99, 10.47) | 2.59  (0.79, 8.46) | 2.74  (0.94, 7.98) | 2.59  (0.79, 8.53) | 1.62  (0.81, 8.44) |
| 6 | 5.09  (1.52, 17.05) | 4.05  (1.23, 13.35) | 3.59  (1.27, 10.16) | 4.10  (1.27, 13.24) | 3.99  (1.34, 11.88) |
| 7 | 7.56  (2.17, 26.37) | 6.00  (1.62, 22.22) | 5.0  (1.61, 15.48) | 6.39  (1.79, 22.72) | 6.21  (1.95, 19.74) |
| 8 | 12.98  (4.26, 39.53) | 9.73  (2.97, 34.84) | 8.73  (3.18, 23.97) | 11.13  (3.33, 37.14) | 11.13  (3.58, 34.57) |
| 9 |  | 11.14  (4.41, 28.17) | 11.34  (5.26, 24.47) |  |  |
| 10 |  | 11.08  (5.08, 24.14) | 14.07  (7.22, 27.40) |  |  |
| 11 |  | 9.52  (4.87, 18.60) | 15.16  (9.69, 23.73) |  |  |
| 12 |  | 7.35  (3.47, 15.57) | 11.58  (6.24, 21.49) |  |  |

Results come from a negative binomial model with city population model as an offset, the week before re-opening as reference, and robust standard errors clustered at the city level. Models further adjusted for mask mandates, stay at home orders, eviction moratoriums, and week and city fixed effects. *Alternative Specification 1*: period extended to 4 weeks pre and 12 post (assumed 2-week lag). *Alternative Specification 2:* specification 1 + no NPI 4+ week limitation. *Alternative Specification 3*: main model with 3-week NPI lag. *Alternative Specification 4:* main model with 4-week NPI lag.

## eFigure D3: Trends in Death Rates Comparing Treatment and Comparison Groups

Graphical user interface, chart, line chart

Description automatically generated

SOURCE: Authors’ analysis of city/county-level COVID-19 death data between April and November of 2020. NOTES: comparison cities include Atlanta, Austin, Charleston, Dallas, Houston, Phoenix, and San Antonio; treatment cities include Indianapolis, Milwaukee, Philadelphia, and San Francisco. Vertical black line represents a 35-day lag after re-opening (comparison cities) or the date the state allowed the city to re-open, but the city stayed closed (treatment cities).

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