Supplementary Information for
Socio-Spatial Patterns of Suicide Mortality in the United States

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This document includes the following:

- Supplementary Text

- Supplementary Figures S1 to S5

- Supplementary Tables S1 to S6

Data Description

All analyses used death counts aggregated at county level for years 2010 to 2022. Suicide mortality data were obtained from the National Vital Statistics System (NVSS) Multiple Cause-of-Death files, restricted to death records with an underlying cause-of-death corresponding to ICD-10 codes X60–X84 or Y87.0. The annual population size of each county was used to calculate mortality rates. Annual population sizes were drawn from the CDC Bridged-Race Postcensal Population Estimates and extracted for a total of 18 five-year age groups (0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85+). These estimates are harmonized for intercensal consistency and aligned with official age groupings. Demographic and socioeconomic variables used for adjustment, including median household income, racial/ethnic composition, educational attainment, unemployment rate, and limited English proficiency, were derived from the American Community Survey (ACS) 5-Year Estimates. Political affiliation was obtained from the MIT Election Data and Science Lab. We considered county-level presidential election returns for 2008, 2012, 2016, and 2020, and defined a binary indicator based on plurality vote share. For non-election years, the value was assigned based on the most recent preceding election. Social connectedness metrics were calculated using the 2018 version of Meta's Social Connectedness Index (SCI). Geospatial coordinates and land area were sourced from the US Census Bureau's TIGER/Line shapefiles. All datasets were merged using 5-digit FIPS county codes.

Supplementary Analysis Using Age-Adjusted Suicide Mortality Rates

We evaluated the robustness of our findings to different outcome specifications. Our primary analysis used crude mortality rates as outcomes and included three variables characterizing the age composition of a given county in a given year as regressors (i.e., the share of the county's population aged below 18, 18–44, and 45–64). In a supplementary analysis, we evaluated whether the associations reported in the main manuscript were robust to the use of age-adjusted suicide mortality rates rather than crude suicide mortality rates. To that end, we re-estimated all models using age-adjusted suicide mortality rates, enabling the comparison of county-level outcomes standardized to the same reference population. In these models, we removed the three variables related to a given county's age structure and listed above from the set of regressors.

Age Standardization of Suicide Mortality Rates

Age-adjusted suicide mortality rates were derived using direct standardization with the *2000 US Standard Population*. Death counts and population sizes were derived using NVSS age recodes (27-category), harmonized to the following **18 age groups**: 0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85+.

Let $d_{it}^{(a)}$ and $p_{it}^{(a)}$ denote the number of suicide deaths and the population size of age group a in county i and year t. Let $w^{(a)}$ denote the population share corresponding to age group a in the 2000 US Standard Population. The age-adjusted suicide mortality rate $\tilde{y}_{it}$ is given by:

$$\tilde{y}_{it} = 100{,}000 \times \sum_a w^{(a)} \frac{d_{it}^{(a)}}{p_{it}^{(a)}} \tag{S1}$$

Following CDC guidelines, estimates were suppressed for any county-year pair with fewer than 10 suicide deaths to ensure reliability and confidentiality.

Alternative Outcome Definitions and Model Specifications to Learn Socio-spatial Patterns of Suicide Mortality in the US

As mentioned above, we conducted a supplementary analysis by re-estimating the models presented in the main manuscript with *age-adjusted suicide mortality rates* $(\tilde{y}_{it})$ as outcomes. This adjustment accounts for the heterogeneity in the age composition of US

counties. Age-standardization was performed using direct standardization over 18 age groups: 0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85+, as defined in NVSS age recodes (27-category). Age-adjusted suicide mortality rates are expressed as the number of suicide deaths per 100,000 people.

Similarly to the analysis presented in the main manuscript, we estimated two-way fixed effects regression models, incorporating county and year fixed effects to account for unmeasured time-invariant county characteristics and nationwide temporal shocks. The first model specification included "deaths in social proximity" ($\tilde{s}_{-it}$) as the main exposure. The second model specification additionally included "deaths in spatial proximity" ($\tilde{d}_{-it}$) as a control to disentangle the role of social connectedness from that of geographical proximity. Demographic and socioeconomic covariates included population density, racial composition (shares of Asian, Black, and Other subgroups), ethnic composition (share of Hispanic population), median household income, unemployment rate, limited English proficiency, and educational attainment. The three variables related to a given county's age structure were removed from the set of regressors.

Using age-adjusted suicide mortality rates ($\tilde{y}_{jt}$), we recomputed the two proximity-based exposure metrics:

$$\tilde{s}_{-it} = \sum_{j \neq i} w_{ij} \tilde{y}_{jt} \tag{S2}$$

$$\tilde{d}_{-it} = \sum_{j \neq i} a_{ij} \tilde{y}_{jt} \tag{S3}$$

where w_{ij} and a_{ij} represent SCI-based and inverse-distance-based weights, respectively, defined identically to those in the main manuscript.

The model estimating the association between the suicide mortality rate of a given focal county and those in socially connected and spatially proximal counties was specified as follows:

$$\tilde{y}_{it} = \eta_1 \tilde{s}_{-it} + \eta_2 \tilde{d}_{-it} + \boldsymbol{\eta_3}^\top \overline{X}_{it} + \mu_i + \phi_t + \varepsilon_{it} \tag{S4}$$

Here, $\tilde{y}_{it}$ denotes the age-adjusted suicide mortality rate in county i and year t; $\tilde{s}_{-it}$ represents the standardized suicide mortality rate in counties socially connected to county i according to Facebook's SCI; $\tilde{d}_{-it}$ represents the inverse-distance-weighted suicide mortality rate in spatially proximal counties; $\overline{X}_{it}$ is a vector of county- and year-specific demographic and socioeconomic covariates; μ_i and ϕ_t denote county and year fixed effects, respectively; and ε_{it} is the error term.

In a first model, we estimated the association between $\tilde{y}_{it}$ and $\tilde{s}_{-it}$ without controlling for spatial exposure. A one-standard-deviation increase in the suicide mortality rate of socially connected counties was associated with an increase of 1.29 deaths per 100,000 people in a focal county (cluster-robust 95% CI: [0.87, 1.70], $p < 0.01$; Fig. S1, red point). The magnitude of this association is sizable, relative to the average suicide mortality rate across US counties over the study period.

In a second model, we included deaths in spatial proximity ($\tilde{d}_{-it}$) as part of the regressors. Under this second specification, the association between the suicide mortality rate of a focal county and that of socially connected counties remained statistically significant, albeit of smaller magnitude than under the first specification (1.09 (95% CI: [0.66, 1.52], $p < 0.01$; Fig. S1, blue point). Compared to the results of the main analysis presented in Table 1, where the point estimates for the first and second models were 3.34 and 2.78 respectively, the effect sizes estimated using age-adjusted suicide mortality rates as outcomes are attenuated by approximately 60%. This attenuation likely owes to differences in outcome definitions: while crude suicide mortality rates cannot be compared among counties with differing age composition, age-adjusted suicide mortality rates can be compared since they reflect the burden in a population whose age composition has been aligned with the 2000 US Standard Population.

Despite this attenuation, the direction and statistical significance of the estimated associations are consistent across outcome definitions and model specifications, providing evidence for the robustness of the relation between social exposure and suicide mortality. Full regression results are provided in Table S1. Overall, our findings suggest that suicide risk is shaped by social connectedness among counties, beyond the role of spatial proximity and age structure.

## ERPO Exposure: Related Evidence and Sensitivity Analyses

Prior evaluations of the impact of intensified ERPO enforcement following high-profile violent incidents found significant reductions in firearm-related suicide mortality, from 7.5% in Indiana to 13.7% in Connecticut (Kivisto et al., 2018). A recent study examining responses from 4,583 ERPO respondents across California, Connecticut, Maryland, and Washington estimated that 17 to 23 ERPOs could prevent one suicide (Swanson et al., 2024). Further, effectiveness was even greater when the petitions explicitly documented suicidal behavior, with only 13 to 18 ERPOs required to prevent one suicide. Additionally, county-level evidence from Oregon highlights the social aspects of ERPO effectiveness, indicating that approximately 73% of petitions explicitly mentioned concerns about suicidal behavior (Zeoli et al., 2021).

To assess the robustness of our findings to the outcome specification, we re-estimated the models evaluating the effect of ERPO exposure using *age-adjusted suicide mortality rates*

Table S1: Estimates of socio-spatial correlates of county-level suicide mortality obtained via two-way fixed effects regressions, using *age-adjusted* death rates. In Model (1), county-level age-adjusted suicide mortality rates ($\tilde{y}_{it}$) are regressed on standardized deaths in social proximity ($\tilde{s}_{-it}$). Model (2) additionally controls for standardized deaths in spatial proximity ($\tilde{d}_{-it}$) to disentangle the role of social ties from that of geographical proximity. Both models include county and year fixed effects and adjust for time-varying county-level characteristics: population density, racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, and percent with less than high school education. Age distribution variables are excluded, as the dependent variable is already adjusted for population structure. Standard errors are clustered at the state level.

	Outcome variable: county-level age-adjusted suicide mortality rate	
	Model 1	Model 2
Deaths in social proximity $\tilde{s}_{-it}$	1.287***	1.089***
	(0.207)	(0.213)
Deaths in spatial proximity $\tilde{d}_{-it}$		0.537**
		(0.238)
Population density	−1.190***	−1.082**
	(0.400)	(0.413)
Percent Asian	−0.766***	−0.764***
	(0.196)	(0.190)
Percent Black	−1.222**	−1.291**
	(0.577)	(0.604)
Percent Other	0.134	0.093
	(0.176)	(0.170)
Percent Hispanic	−3.284***	−3.313***
	(0.817)	(0.773)
Median household income	−0.748***	−0.727***
	(0.148)	(0.149)
Percent with limited English proficiency	−0.065	−0.051
	(0.077)	(0.076)
Percent unemployed	0.164	0.154
	(0.162)	(0.153)
Percent with less than high school education	0.029	0.021
	(0.102)	(0.102)
Observations	40,794	40,794
R^2	0.566	0.566
Adjusted R^2	0.529	0.530

Robust standard errors in parentheses. * p<0.1; ** p<0.05; *** p<0.01
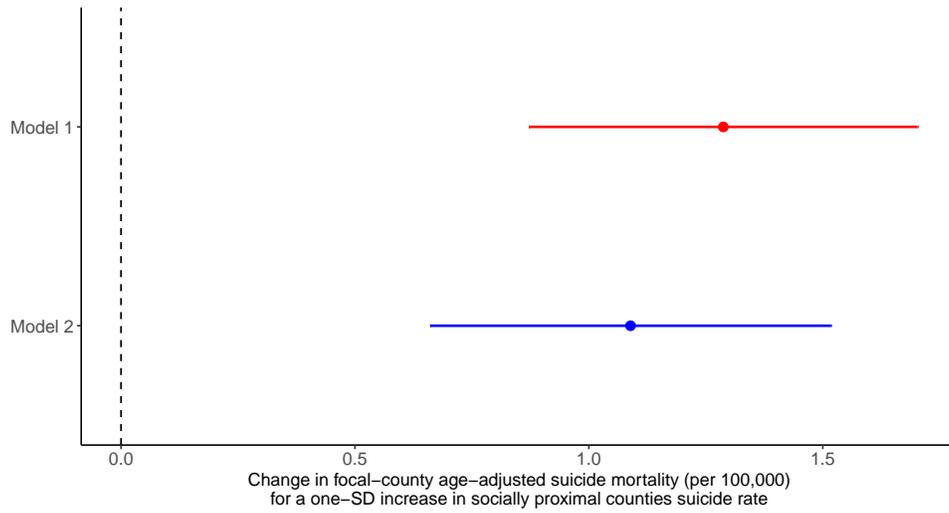
Figure S1: Role of social ties in county-level suicide mortality, with and without controlling for geographical proximity. Estimated regression coefficients ($\hat{\eta}_1$) for suicide mortality rates in socially connected counties ($\tilde{s}_{-it}$) in two models, using age standardization. Model 1 (red): without adjustment for deaths in spatial proximity ($\tilde{d}_{-it}$). Model 2 (blue): with adjustment for deaths in spatial proximity ($\tilde{d}_{-it}$). Horizontal lines denote 95% confidence intervals (CI). The vertical dashed line indicates the null hypothesis ($\eta_1 = 0$). Point estimate in model 1: 1.29 (95% CI: [0.87, 1.70]); point estimate in model 2: 1.09 (95% CI: [0.66, 1.52]). All models include county and year fixed effects as well as time-varying county-level demographic and socioeconomic control variables (see Table S1).

$(\tilde{y}_{it})$ as outcomes. This alternative outcome definition accounts for demographic hetero-geneity between counties and helps to disentangle variation in suicide risk from variation in age structure. Age standardization was performed using direct standardization across 18 age groups defined by the NVSS age recode system, as explained above. Age-adjusted suicide mortality rates were expressed in terms of the number of suicide deaths per 100,000 people.

We estimated three fixed effects models. The first model considered the direct effect of ERPO implementation. The second model considered the indirect effect of social exposure to ERPOs, through social ties. The third model included both social and spatial ERPO exposure as regressors. The first model specification included county (ϕ_i) and year (ϕ_t) fixed effects, while the second and third model specifications included county fixed effects and state-by-year fixed effects (γ_{st}).

The specification for the first model is as follows:

$$\tilde{y}_{it} = \kappa_1 ERPO_{it} + \boldsymbol{\kappa}_2^\top \overline{X}_{it} + \phi_i + \gamma_t + \varepsilon_{it}.$$

The specification for the second model is as follows:

$$\tilde{y}_{it} = \tau_1 ERPO\ Social\ Exposure_{it} + \boldsymbol{\tau}_2^\top \overline{X}_{it} + \phi_i + \gamma_{st} + \varepsilon_{it}.$$

The specification for the third model is as follows:

$$\tilde{y}_{it} = \omega_1 ERPO\ Social\ Exposure_{it} + \omega_2 ERPO\ Spatial\ Exposure_{it} + \boldsymbol{\omega}_3^\top \overline{X}_{it} + \phi_i + \gamma_{st} + \varepsilon_{it}.$$

In the above, $\tilde{y}_{it}$ is the age-adjusted suicide mortality rate in county i and year t; $ERPO\ Social\ Exposure_{it}$ represents the standardized share of social ties to counties located in ERPO-implementing states; $ERPO\ Spatial\ Exposure_{it}$ corresponds to the inverse-distance-weighted spatial exposure to counties located in ERPO-implementing states; and $\overline{X}_{it}$ represents county- and year-specific demographic and socioeconomic control variables.

Direct effects of ERPO implementation. Using the first model, we estimated that ERPO implementation in a given state was associated with a reduction of $\widehat{\kappa} = -0.6112$ (cluster-robust 95% CI: [-1.00, -0.22]) deaths per 100,000 people at the county level. Such a reduction is substantial and highlights the potential population-level benefits of expanding the implementation of ERPOs to other states. Of note, because the ERPO variable varies at the state–year level, we clustered standard errors by state to ensure conservative inference.

Indirect effects of ERPO implementation through social ties. Using the second model, we estimated that a one-standard-deviation increase in social connectedness to

counties located in ERPO-implementing states was associated with a reduction of $\widehat{\tau}_1 = -0.218$ (cluster-robust 95% CI: [-0.313, -0.123]) deaths per 100,000 people in a given focal county. This finding suggests that greater social proximity to counties with active ERPO policies is associated with measurable reductions in age-adjusted suicide mortality, independently of local legislation.

Effects of social and spatial exposures to ERPO implementation. When additionally controlling for geographical proximity to counties located in ERPO-implementing states in the third model, we estimated a reduction of $\widehat{\omega}_1 = -0.253$ (cluster-robust 95% CI: [-0.394, -0.111]) deaths per 100,000 people for a one-standard-deviation increase in social connectedness to counties located in ERPO-implementing states. Such robustness in the estimated indirect effect of social exposure to ERPOs suggests that social networks play a protective role, beyond geographical proximity to ERPO-implementing states.

Comparison between results from main versus supplementary analyses. The magnitude of the estimated indirect effects of ERPO implementation, through social ties, was slightly attenuated in our supplementary analyses using age-adjusted rather than crude suicide mortality rates; yet the directionality and significance of the results remained consistent with the main analysis. In sum, our findings were robust to alternative outcome definitions and model specifications, reinforcing that both direct and indirect exposure to ERPO implementation can contribute to reductions in suicide mortality.

Robustness Test: Controlling for Deaths in Social Proximity

To further validate our findings, we conducted a robustness test by building a model that additionally controls for deaths in socially connected counties. This alternative specification helps address potential confounding that arises from the correlated suicide mortality rates in the social network. Specifically, social connectedness may serve as a proxy for shared environmental characteristics prone to elevated suicide risk or common cultural and structural determinants of suicide that operate independently of ERPO policies. Without accounting for these baseline correlations in suicide mortality, the estimated effects of ERPO social exposure could reflect pre-existing social network-level patterns rather than true policy impacts.

We estimated two fixed effects models. The first model considered crude suicide mortality rates as outcomes, while the second model considered age-adjusted mortality rates as outcomes. Both models included standardized social and spatial ERPO exposure variables. Additionally, both models included county fixed effects (ϕ_i) and state-by-year fixed effects (γ_{st}), with standard errors clustered at the state level. The control variables for deaths in social proximity (s_{-it} in the first model and $\tilde{s}_{-it}$ in the second model) correspond to the SCI-weighted average of contemporaneous suicide mortality in socially connected counties, excluding the focal county itself. By adjusting for these network-level suicide

S8
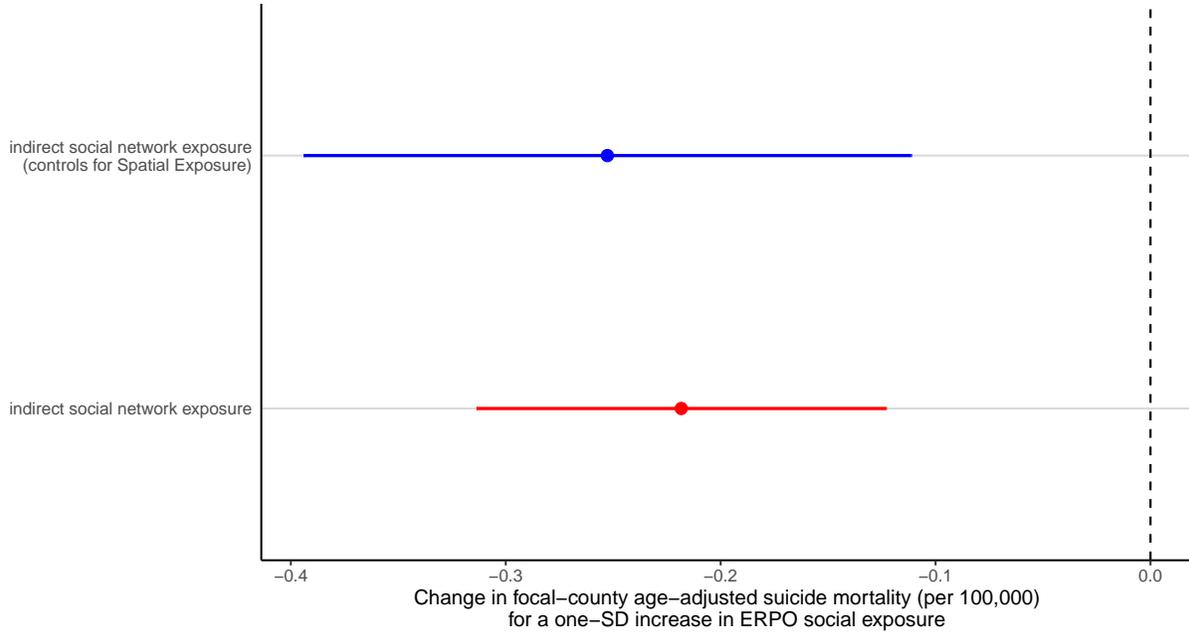
Figure S2: Indirect effects of ERPO implementation on suicide mortality, through social ties, with and without controlling for geographical proximity. Estimated regression coefficients ($\hat{\tau}_1$, $\hat{\omega}_1$) for *ERPO Social Exposure* in two models. Baseline model (red): without controlling for *ERPO Spatial Exposure*. Alternative model (blue): controlling for *ERPO Spatial Exposure*. Point estimate in baseline model: ($\hat{\tau}_1 = -0.218$, cluster-robust 95% CI: $[-0.314, -0.123]$); point estimate in alternative model: ($\hat{\omega}_1 = -0.253$, cluster-robust 95% CI: $[-0.394, -0.111]$). Horizontal lines denote 95% confidence intervals (CI). The vertical dashed line indicates the null hypothesis ($\tau_1 = 0$). Both models included county and state–year fixed effects (ϕ_i, γ_{st}) as well as demographic and socioeconomic control variables ($\overline{X}_{it}$).

Table S2: Estimated effects of ERPO policy exposure on county-level *age-adjusted* suicide mortality rates (expressed in terms of the number of deaths per 100,000 people). Column (1) reports direct effects of local ERPO implementation with county and year fixed effects. Column (2) reports indirect effects of ERPO social exposure, measured through inter-county social ties, estimated with county and state–year fixed effects. Column (3) reports results from the indirect social exposure model, with an additional control for ERPO spatial exposure as well as county and state–year fixed effects. All models adjust for population density, racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, percent with less than high school education, and political affiliation. Standard errors are clustered at the state level.

	Outcome variable: county-level age-adjusted suicide mortality rate		
	(1)	(2)	(3)
ERPO	−0.611***		
	(0.195)		
ERPO social exposure		−0.218***	−0.253***
		(0.047)	(0.070)
ERPO spatial exposure			0.276
			(0.267)
Population density	−1.553***	−0.639	−0.671
	(0.422)	(0.532)	(0.516)
Percent Asian	−1.355**	−2.411***	−2.344***
	(0.528)	(0.614)	(0.600)
Percent Black	−0.929***	−0.507***	−0.491***
	(0.226)	(0.172)	(0.170)
Percent Other	0.213	−0.048	−0.062
	(0.191)	(0.188)	(0.191)
Percent Hispanic	−3.460***	−1.546***	−1.585***
	(0.989)	(0.555)	(0.562)
Median household income	−0.729***	−0.635***	−0.611***
	(0.166)	(0.224)	(0.221)
Percent with limited English proficiency	−0.092	−0.151*	−0.157**
	(0.082)	(0.076)	(0.073)
Percent unemployed	0.181	−0.102	−0.099
	(0.171)	(0.135)	(0.136)
Percent with less than high school education	0.057	−0.077	−0.094
	(0.124)	(0.109)	(0.109)
Political affiliation	0.036	0.140	0.124
	(0.164)	(0.152)	(0.154)
Observations	40,794	40,794	40,794
R^2	0.565	0.575	0.577
Adjusted R^2	0.528	0.532	0.534

Robust standard errors in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

mortality patterns, we can isolate the effect of ERPO social exposure.

The regression equation for the first model is as follows:

$$
\begin{aligned}
y_{it} = {} & \alpha_1 \, ERPO \; Social \; Exposure_{it} + \alpha_2 \, ERPO \; Spatial \; Exposure_{it} \\
& + \alpha_3 \, s_{-it} + \boldsymbol{\alpha}_4^\top \, \overline{X}_{it} + \phi_i + \gamma_{st} + \varepsilon_{it}.
\end{aligned}
\tag{S5}
$$

The regression equation for the second model is as follows:

$$
\begin{aligned}
\tilde{y}_{it} = {} & \vartheta_1 \, ERPO \; Social \; Exposure_{it} + \vartheta_2 \, ERPO \; Spatial \; Exposure_{it} \\
& + \vartheta_3 \, \tilde{s}_{-it} + \boldsymbol{\vartheta}_4^\top \, \overline{X}_{it} + \phi_i + \gamma_{st} + \varepsilon_{it},
\end{aligned}
\tag{S6}
$$

where y_{it} is the crude suicide mortality rate in county i and year t (expressed in terms of the number of deaths per 100,000 people); $\tilde{y}_{it}$ is the corresponding age-adjusted suicide mortality rate; $ERPO \; Social \; Exposure_{it}$ and $ERPO \; Spatial \; Exposure_{it}$ are social and spatial ERPO exposure variables given by Equations (5) and (7) in *Methods*; s_{-it} is the SCI–weighted average of *crude* suicide deaths in socially connected counties ($j \neq i$); $\tilde{s}_{-it}$ is the corresponding *age-adjusted* variable; and $\overline{X}_{it}$ denotes time-varying county-level demographic and socioeconomic control variables. All specifications include county fixed effects (ϕ_i) and state-by-year fixed effects (γ_{st}); inference uses robust standard errors clustered by state.

The negative association between suicide mortality in a given focal county and ERPO social exposure remained robust after controlling for contemporaneous suicide mortality in socially connected counties. As shown in Figure S3 and Tables S3 and S4, estimated coefficients for the ERPO social exposure variable were consistently negative and statistically significant, irrespective of whether crude suicide mortality rates ($\hat{\alpha}_1 = -0.304$, 95% CI: $[-0.472, -0.136]$) or age-adjusted suicide mortality rates ($\hat{\vartheta}_1 = -0.270$, 95% CI: $[-0.420, -0.120]$) were used as outcomes. Notably, the association between suicide mortality in a given focal county and deaths in social proximity was statistically significant in the model using age-adjusted suicide mortality rates ($\hat{\vartheta}_3 = -0.428$, $p < 0.05$) but not in the model using crude suicide mortality rates. This divergence likely reflects the role of the age standardization procedure, which removes heterogeneity in county-level age composition and can thus help better reveal underlying correlations in suicide mortality across socially connected counties that may otherwise be masked by differing age structures. Critically, the inclusion of this control variable did not materially alter the magnitude or significance of the association between suicide mortality and ERPO social exposure under any model specification. The robustness of our findings suggests that indirect exposure to ERPOs through social ties independently explains reductions in suicide mortality in counties located in non-implementing states.
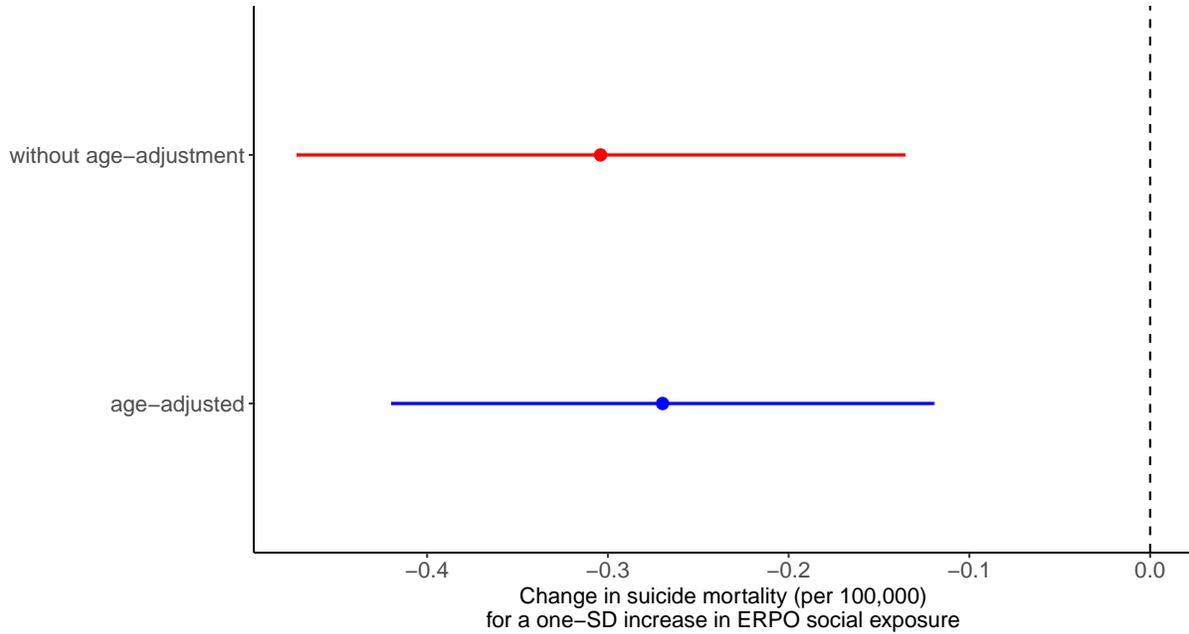
Figure S3: Role of social ties in county-level suicide mortality, with and without age standardization. Estimated regression coefficients ($\hat{\alpha}_1$, $\hat{\vartheta}_1$) for *ERPO Social Exposure* in two models, both controlling for deaths in social proximity. Baseline model (red): without age standardization. Alternative model (blue): with age standardization. Point estimate in baseline model: ($\hat{\alpha}_1 = -0.304$, cluster-robust 95% CI: $[-0.472, -0.136]$); point estimate in alternative model: ($\hat{\vartheta}_1 = -0.270$, cluster-robust 95% CI: $[-0.420, -0.120]$). Horizontal lines denote 95% confidence intervals (CI). The vertical dashed line indicates the null hypothesis. Both models include county and state-by-year fixed effects (ϕ_i, γ_{st}), demographic and socioeconomic control variables ($\overline{X}_{it}$), and a variable characterizing deaths in social proximity (s_{-it} or $\tilde{s}_{-it}$).

Table S3: Estimated effects of ERPO policy exposure on county-level crude suicide mortality rates (expressed in terms of the number of deaths per 100,000 people). The estimated effects includes county and state–year fixed effects. The model adjusts for deaths in social proximity s_{-it}, population density, age distribution (percent aged 0–17, 18–44 and 45–64), racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, percent with less than high school education, and political affiliation. Standard errors are clustered at the state level.

Outcome variable: county-level crude suicide mortality rate (per 100,000 people)	
ERPO social exposure	−0.304***
	(0.084)
ERPO spatial exposure	0.514
	(0.312)
Deaths in social proximity s_{-it}	−0.491
	(1.149)
Population density	−0.652
	(0.587)
Percent aged 0-17	−0.186
	(0.370)
Percent aged 18-44	−0.121
	(0.556)
Percent aged 45-64	−0.514
	(0.402)
Percent Asian	−0.646**
	(0.254)
Percent Black	−2.790***
	(0.681)
Percent Other	−0.122
	(0.280)
Percent Hispanic	−2.876***
	(0.826)
Median household income	−0.603***
	(0.186)
Percent with limited English proficiency	−0.050
	(0.129)
Percent unemployed	−0.098
	(0.125)
Percent with less than high school education	−0.052
	(0.124)
Political affiliation	0.138
	(0.156)
Observations	40,794
R^2	0.947
Adjusted R^2	0.941

Robust standard errors in parentheses. * p<0.1; ** p<0.05; *** p<0.01

Table S4: Estimated effects of ERPO policy exposure on county-level age-adjusted suicide mortality (expressed in terms of the number of deaths per 100,000 people). The model includes county and state–year fixed effects. The model adjusts for deaths in social proximity $\widetilde{s}_{-it}$ population density, racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, percent with less than high school education, and political affiliation. Standard errors are clustered at the state level.

	Outcome variable: county-level age-adjusted suicide mortality rate (per 100,000 people)
ERPO Social Exposure	−0.270***
	(0.075)
ERPO Spatial Exposure	0.275
	(0.280)
Deaths in social proximity $\tilde{s}_{-it}$	−0.428**
	(0.205)
Population density	−0.702
	(0.534)
Percent Asian	−2.361***
	(0.609)
Percent Black	−0.529***
	(0.173)
Percent Other	−0.073
	(0.195)
Percent Hispanic	−1.666***
	(0.597)
Median household income	−0.621***
	(0.221)
Percent with limited English proficiency	−0.159**
	(0.074)
Percent unemployed	−0.094
	(0.137)
Percent with less than high school education	−0.094
	(0.110)
Political Affiliation	0.131
	(0.154)
Observations	40,794
R^2	0.577
Adjusted R^2	0.534

Robust standard errors in parentheses. * p<0.1; ** p<0.05; *** p<0.01

Robustness to the Updated Social Connectedness Index

To assess the sensitivity of our findings to the measurement of social ties, we repeated our main analyses using the updated 2026 release of the SCI. The results are reported in Table S5 and Table S6, with corresponding coefficient plots shown in Figures S4 and S5.

The estimated association between suicide mortality and deaths in socially-connected counties remains positive and statistically significant, both without adjustment for spatial proximity (Model 1R: $\hat{\zeta}_1 = 3.32$, 95% CI: [1.75, 4.89]) and after controlling for deaths in spatially proximate counties (Model 2R: $\hat{\zeta}_1 = 2.79$, 95% CI: [1.07, 4.51]). These estimates are closely aligned with those obtained using the 2021 SCI data, confirming that the role of social ties in county-level suicide mortality is not an artifact of a particular vintage of the connectedness measure.

Similarly, the estimated effects of indirect ERPO policy exposure through social networks are robust to the updated SCI. The baseline social exposure estimate ($\hat{\delta}_1 = -0.210$, 95% CI: [−0.342, −0.080]) and the estimate controlling for spatial exposure ($\hat{\theta}_1 = -0.292$, 95% CI: [−0.467, −0.117]) both remain negative and statistically significant, while spatial exposure itself is not significant. The direction, magnitude, and statistical significance of all key coefficients are substantively unchanged relative to the main specification.

These results demonstrate that our core findings about the significance of social connectedness for county-level suicide mortality and the protective association of indirect ERPO exposure through social ties are robust to measurement updates in the underlying social network data.
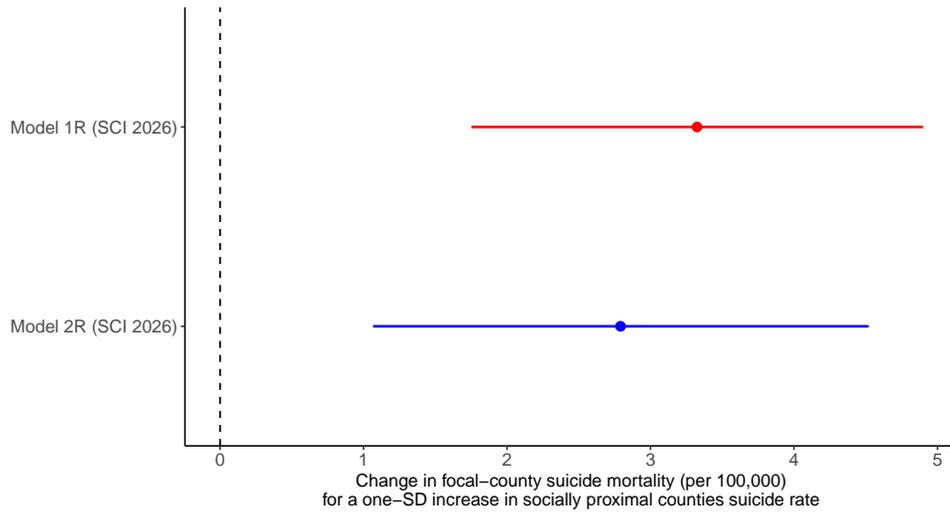
Figure S4: Role of social ties in county-level suicide mortality. Estimated regression coefficients $(\hat{\zeta}_1)$ for suicide mortality rates in socially-connected counties (s_{-it}) in two models. Model 1R (SCI 2026) (red): without adjustment for deaths in spatial proximity (d_{-it}). Model 2R (SCI 2026) (blue): with adjustment for deaths in spatial proximity (d_{-it}). Horizontal lines denote 95% confidence intervals (CI). The vertical dashed line indicates the null hypothesis $(\zeta_1 = 0)$. Point estimate in model 1: 3.32 (cluster-robust 95% CI: [1.75, 4.89]); point estimate in model 2: 2.79 (cluster-robust 95% CI: [1.07, 4.51]). Both models include county and year fixed effects and sociodemographic control variables (see Table S5).

Table S5: Estimates of socio-spatial correlates of county-level suicide mortality obtained via two-way fixed effects regressions. In Model 1R (SCI 2026), county-level suicide mortality rates are regressed on standardized deaths in social proximity (s_{-it}). Model 2R (SCI 2026) additionally controls for standardized deaths in spatial proximity (d_{-it}) to disentangle the role of social ties from that of geographical proximity. Both models include county and year fixed effects and adjust for time-varying county-level characteristics: population density, age distribution (percent aged 0–17, 18–44 and 45–64), racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, and percent with less than high school education. Standard errors are clustered at the state level.

	Outcome variable: county-level crude suicide mortality rate	
	Model 1R (SCI 2026)	Model 2R (SCI 2026)
Deaths in social proximity s_{-it}	3.324***	2.791***
	(0.782)	(0.858)
Deaths in spatial proximity d_{-it}		0.753**
		(0.324)
Population density	−1.187***	−0.998**
	(0.371)	(0.374)
Percent aged below 18	−0.209	−0.198
	(0.348)	(0.341)
Percent aged 18-44	0.337	0.146
	(0.541)	(0.533)
Percent aged 45-64	−0.809***	−0.844***
	(0.294)	(0.284)
Percent Asian	−0.833***	−0.817***
	(0.292)	(0.289)
Percent Black	−1.350*	−1.388*
	(0.746)	(0.766)
Percent Other	0.361**	0.302*
	(0.179)	(0.162)
Percent Hispanic	−3.651***	−3.543***
	(0.804)	(0.809)
Median household income	−0.700***	−0.693***
	(0.165)	(0.168)
Percent with limited English proficiency	−0.067	−0.038
	(0.075)	(0.072)
Percent unemployed	0.023	0.032
	(0.157)	(0.150)
Percent with less than high school education	−0.018	−0.027
	(0.124)	(0.123)
Observations	40,794	40,794
R^2	0.946	0.946
Adjusted R^2	0.941	0.941
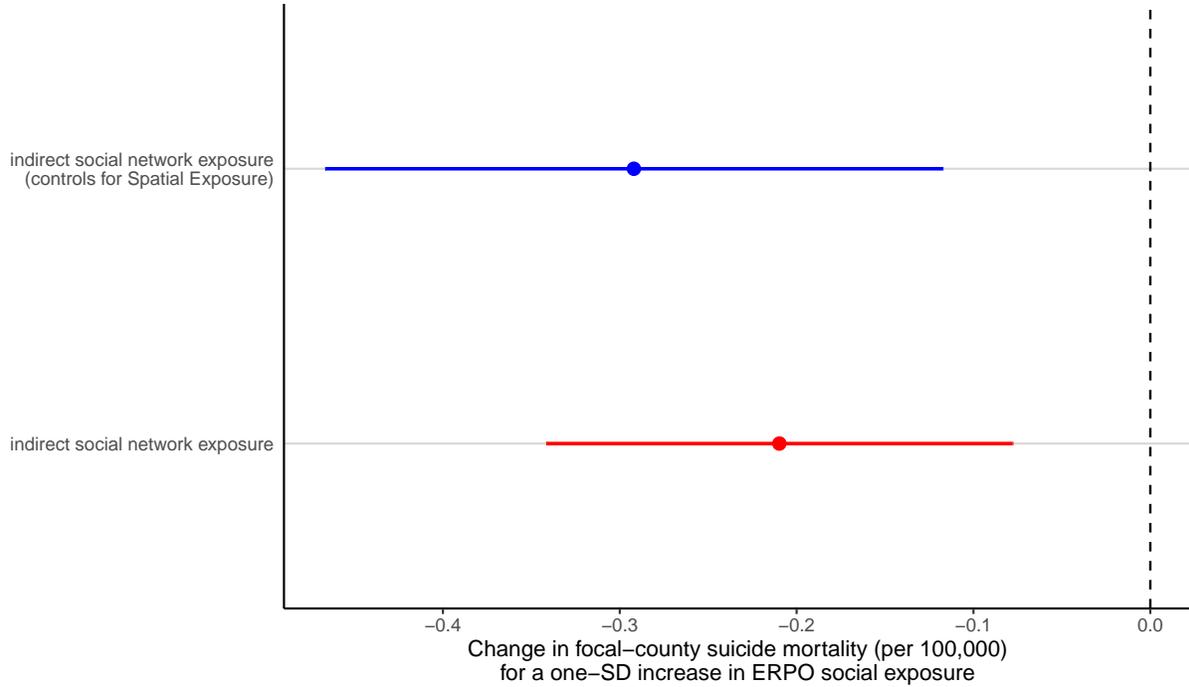
Figure S5: Estimated coefficients $(\hat{\delta}_1,\ \hat{\theta}_1)$ for ERPO social exposure in two specifications. Red point indicates estimate from the baseline model without spatial exposure ($\hat{\delta}_1 = -0.210$, cluster-robust 95% CI: $[-0.342, -0.0799]$); blue point indicates estimate from the specification controlling for *ERPO Spatial Exposure$_{it}$* ($\hat{\theta}_1 = -0.292$, cluster-robust 95% CI: $[-0.467, -0.117]$). Horizontal lines denote 95% confidence intervals; vertical dashed line denotes the null hypothesis ($\delta_1 = 0$). Both models include county and state–year fixed effects ($\phi_i,\ \gamma_{st}$) and sociodemographic controls ($\overline{X}_{it}$). Consistent negative and statistically significant estimates indicate the association between suicide mortality and indirect social exposure to ERPO policies is robust to spatial confounding.

Table S6: Estimated effects of ERPO policy exposure using 2026 SCI data on county-level crude suicide mortality rates (expressed in terms of the number of deaths per 100,000 people). Column (1) reports direct effects of local ERPO implementation with county and year fixed effects. Column (2) reports indirect effects of ERPO social exposure, measured through inter-county social ties, estimated with county and state–year fixed effects. Column (3) reports results from the indirect social exposure model, with an additional control for ERPO spatial exposure as well as county and state–year fixed effects. All models adjust for population density, age distribution (percent aged 0–17, 18–44 and 45–64), racial composition (percent Asian, Black, and Other racial subgroups), ethnic composition (percent Hispanic), median household income, percent with limited English proficiency, percent unemployed, percent with less than high school education and political affiliation. Standard errors are clustered at the state level.

	Outcome variable: county-level crude suicide mortality rate		
	(1)	(2)	(3)
ERPO	−0.528**		
	(0.200)		
ERPO Social Exposure		−0.210***	−0.292***
		(0.066)	(0.087)
ERPO Spatial Exposure			0.517
			(0.314)
Population density	−1.453***	−0.537	−0.557
	(0.373)	(0.592)	(0.578)
Percent aged below 18	−0.103	−0.227	−0.213
	(0.361)	(0.372)	(0.374)
Percent aged 18-44	0.441	−0.222	−0.144
	(0.559)	(0.545)	(0.542)
Percent aged 45-64	−0.956***	−0.581	−0.523
	(0.331)	(0.388)	(0.402)
Percent Asian	−1.010***	−0.645**	−0.623**
	(0.338)	(0.284)	(0.268)
Percent Black	−1.323*	−2.886***	−2.801***
	(0.722)	(0.685)	(0.677)
Percent Other	0.474**	−0.103	−0.109
	(0.198)	(0.278)	(0.280)
Percent Hispanic	−3.913***	−2.699***	−2.821***
	(0.983)	(0.837)	(0.875)
Median household income	−0.658***	−0.627***	−0.594***
	(0.166)	(0.172)	(0.180)
Percent with limited English proficiency	−0.087	−0.037	−0.056
	(0.077)	(0.131)	(0.127)
Percent unemployed	0.010	−0.117	−0.102
	(0.163)	(0.124)	(0.126)
Percent with less than high school education	0.004	−0.049	−0.058
	(0.144)	(0.123)	(0.123)
Political Affiliation	−0.095	0.155	0.133
	(0.167)	(0.159)	(0.159)
Observations	40,794	40,794	40,794
R^2	0.946	0.947	0.947
Adjusted R^2	0.941	0.941	0.941