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The Relationship Between Community Networks and Population-Level Outcomes

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Tech-Enabled Community Resilience

Our social contract in a resilient community is that we cooperate for the public good and in turn, are able to **rely on our network of neighbors, social organizations, and civic institutions when needed.**

Community Resilience

Tech-Enabled Community Resilience

- **Community as a Network:** “Community resilience is used to describe the interconnected network of systems that directly impact human society at a grassroots community level, including the socioeconomic, ecological, and built environments.” (Clements & Casani, 2016)
- **Community Resilience as a Process:** Community resilience is a dynamic ecosystem process linking a network of adaptive capacities (resources with dynamic attributes) to adaptation after a disturbance or adversity (Norris et al, 2008).

Social Care Networks & Resilience

Tech-Enabled Community Resilience

- **Social care networks:** Formal or informal community or regional partnership of cross-sector organizations in medical care, public health, social services, and other systems. Designed to coordinate, collaborate, share resources, and/or exchange information to refer individuals to services.
- **Social Care Networks to Enhance Resilience:** The dynamic process underlying the *interconnectedness of social care networks is a key factor* in how communities respond to emerging needs, opportunities, and crises.

Social Care Networks & Collaboration

Tech-Enabled Community Resilience

- **Health Equity & Access:** Resilient communities are often accompanied by a strong network of providers and organizations dedicated to collaboratively solving issues related to equitable access to services and resulting outcomes (Corbie-Smith et al, 2019; DeFosset et al, 2023; Gundacker et al, 2020; Hamer & Mays, 2020; Hardin et al 2020).
- **Systematic Review:** Found “*little convincing evidence to suggest that collaboration between local health care and non-health care organizations **improves health outcomes***” (Alderwick, et al, 2021.)

Network Powered Collaboration

Tech-Enabled Community Resilience

- **Complex Adaptive Systems:** We conceptualize social care networks as complex adaptive systems in a community (Anderson, 1999; Benham-Hutchens & Clancy, 2010; Hillman, Withers, & Collins, 2009).
- **Resilient and Responsive:** The adaptive nature of these networks allows communities to collectively contribute to emergent community-level changes and access a more diverse pool of resources to address community needs .
- **Emergent and Non-Linear:** Community-level changes emerge from the interactions of different nodes in the network; dynamic relationships and change are non-linear.

Network Powered Collaboration

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- **Collective Efforts & Coordinated Action:** Diverse agents within these networks can achieve significant community-level changes that are greater than the sum of individual efforts.
- **Holistic Approach to Systems Change:** By leveraging the interconnected nature of various sectors, social care networks can address complex, multifaceted issues that single organizations might struggle with alone.
- **Resilience in Context:** During COVID-19, many communities saw rapid adaptation and cooperation among health services, social services, and community organizations to meet emergent needs.

Current Study

Current Study

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- Social care networks are **designed to have improved access to services in a community and connect individuals to social and behavioral supports** to thrive in times of need.
- From a population health perspective, **social care networks are best positioned to influence community Health Factors** (health behaviors, care access, and social/economic) as **indicators of future community health***.

*University of Wisconsin Population Health Institute. County Health Rankings & Roadmaps 2024. www.countyhealthrankings.org.

Current Study

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- Unlike previous research on social care collaborations, we **quantified the strength and cohesion of the network as a complex adaptive system and as a key driver of community-level change.**
- We conducted **network analysis using service referral interaction data between cross-sector organizations** in each network to derive network cohesion metrics.
 - **Median Closeness Standardized** - centrally positioned efficient nodes
 - **Global Clustering Coefficient** - many locally connected nodes, tight clusters of highly connected neighbors

Current Study

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- A large population of social care networks in our study allowed us to **statistically test group differences in community-level health factors over time as a function of network connectedness and cohesion** .
- We used a **Difference-in Difference** method to test the following hypothesis against the null:
 - Hypothesis: **Stronger, more interconnected social care networks will positively affect social and behavioral factors related to health outcomes**, compared to weaker, less connected networks.

Methods

Design & Methods

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- **Design:** Non-equivalent Groups Design
- **Study Period:** Jan 1, 2020 - Dec 31, 2022
- **Context:** COVID
- **Analysis:** Difference-in-Differences (DiD) Linear Regression

Study Population

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- **Sample Size: 44 counties** in 4 US States served by 22 social care networks



- Cross-Sector Partners**
- Behavioral Health
 - Concrete Supports
 - Developmental Disabilities
 - Early Childhood
 - Maternal & Child Health
 - Health & Public Health
 - Family Support
 - Education
 - Resource Navigation
 - Housing
 - Crisis response, public safety

22 Social Care Networks



Study Population

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	Mean (sd)	Min - Max
Nodes	37.2 (20.4)	6 - 125
Edges	86.9 (89.1)	4 - 563
Triangles	64 (114.0)	1 - 3
Diameter	4.27 (.76)	2 - 6
Network Age (Months)	31.85(18.9)	14.3 - 70.8

22 Social Care Networks



Data Sources

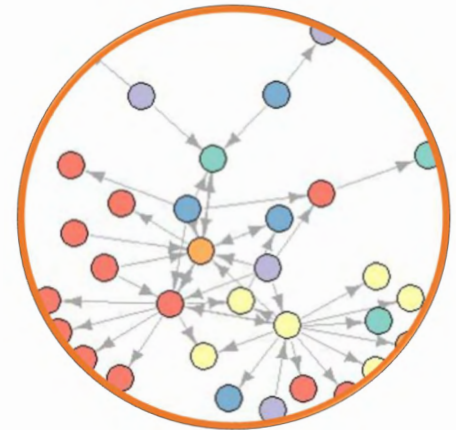
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- **Network Data:** Service referral data between organizations in each social care network collected from the same technology software between **Jan 1, 2022 and Dec 31, 2022**
- **Community-level Health Data:** Standardized county-level data on health factors and outcomes (University of Wisconsin Public Health Institute, 2023) matched by county in each network

Measures: Network Grouping

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- **Independent Variable:** Overall **Network Cohesion** measured by standardized closeness centrality & global clustering coefficient
- **Predictor Group:**
 - 0 (Networks < 50% of mean on both metrics)
 - 1 (Networks > 50% of mean on both metrics)
- **Covariates:** Network Age (months), Baseline Community Health Outcomes

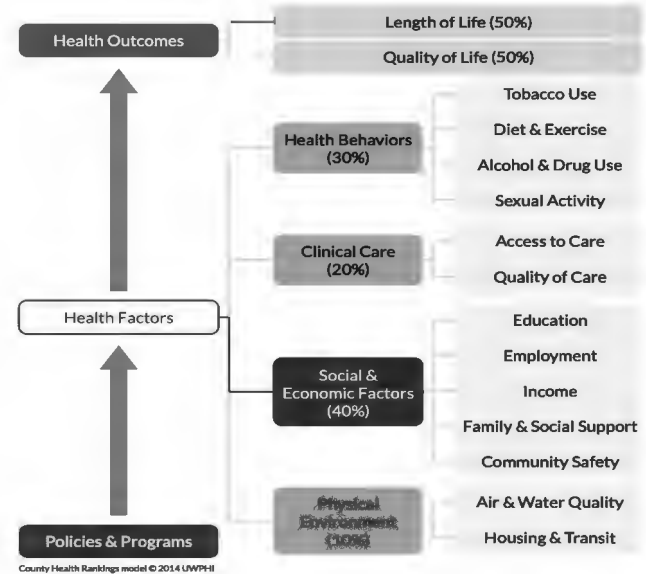


Measures: Community Health Factors

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- **Dependent Variables:** Standardized community Health Factors
 - Health Factors (composite)
 - Health Behaviors
 - Clinical Care
 - Social & Economic Factors

- **Event Factor** (Time)
 - **Time 0:** 2020 - 2021
 - **Time 1:** 2022



Analysis

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- **Difference-in-Difference Test for Non-equivalent Groups**
 - Isolate the effect of an event (in this case, the passage of time) by comparing the changes in outcomes between two groups over time. It statistically removes bias from pre-existing group differences by leveraging the pre-test data.
- **Generalized Linear Model - Estimating Equations** for each Dependent Variable
 - $Y = \beta_0 + \beta_1 \cdot \text{Group} + \beta_2 \cdot \text{Time} + \beta_3 \cdot (\text{Group} \cdot \text{Time}) + \epsilon$
 - Covariates: *Network Age, Baseline Community Health Outcome*

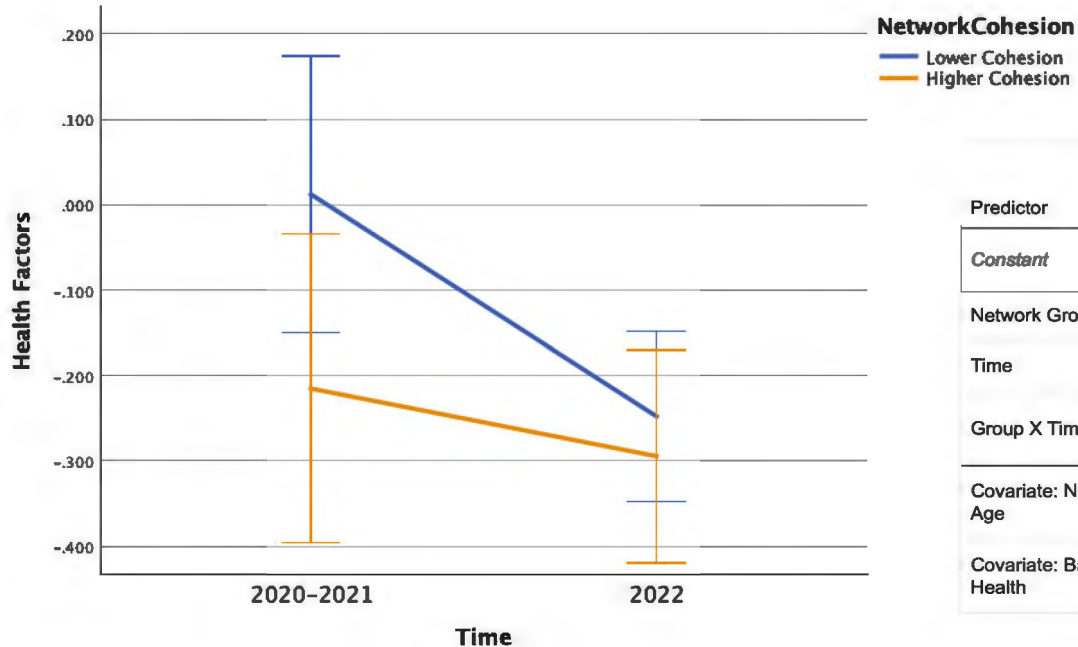
Results

Summary Results

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- **Strong COVID Effect** - Negative Intercept coefficient; As anticipated, every health factor significantly declined over time
- **Network Cohesion Significant Predictor of Community-Level Health Factor Changes** - Difference-in-Difference (Group X Time) test was significant for every dependent variable
- **Highly Cohesive Networks Mitigated the Negative Effects of COVID** - communities with cohesive networks were protected against steep declines experienced by those with less cohesive social care networks

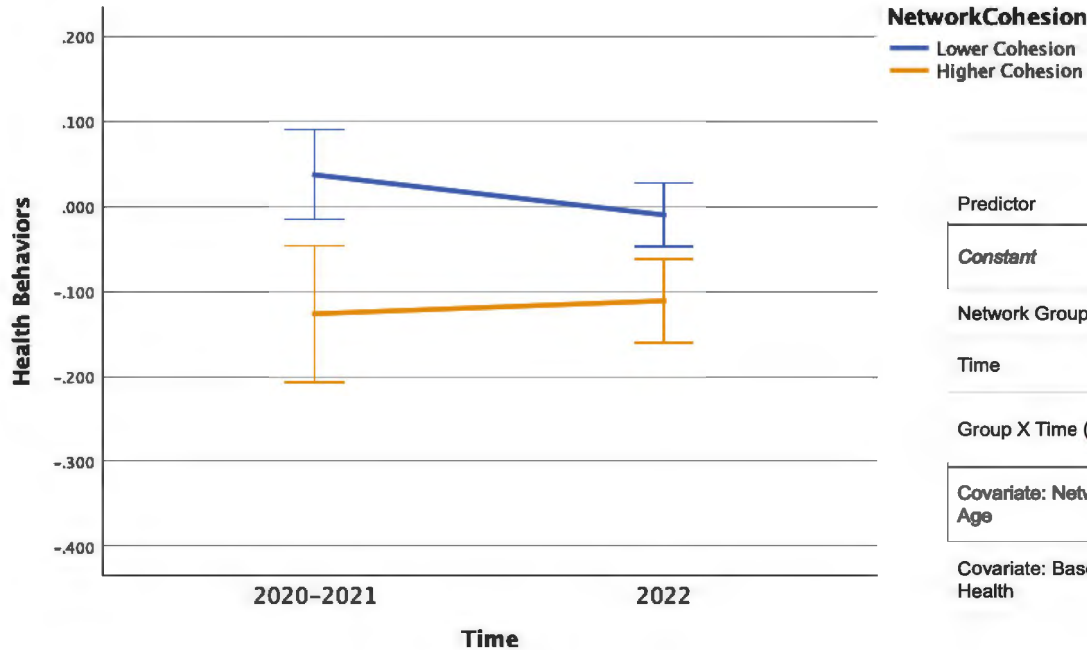
Health Factors Composite



Linear Regression Results

Predictor	Coefficient	Standard Error	Wald Chi-Square	df	p-value
<i>Constant</i>	-0.30	.071	7.76	1	<0.001
Network Group	.025	0.06	3.09	1	0.674
Time	.260	0.04	1.97	1	<.001
Group X Time (DiD)	-.181	0.06	3.30	1	0.003
Covariate: Network Age	.005	0.00	12.97	1	<.001
Covariate: Baseline Health	.383	0.05	49.73	1	<.001

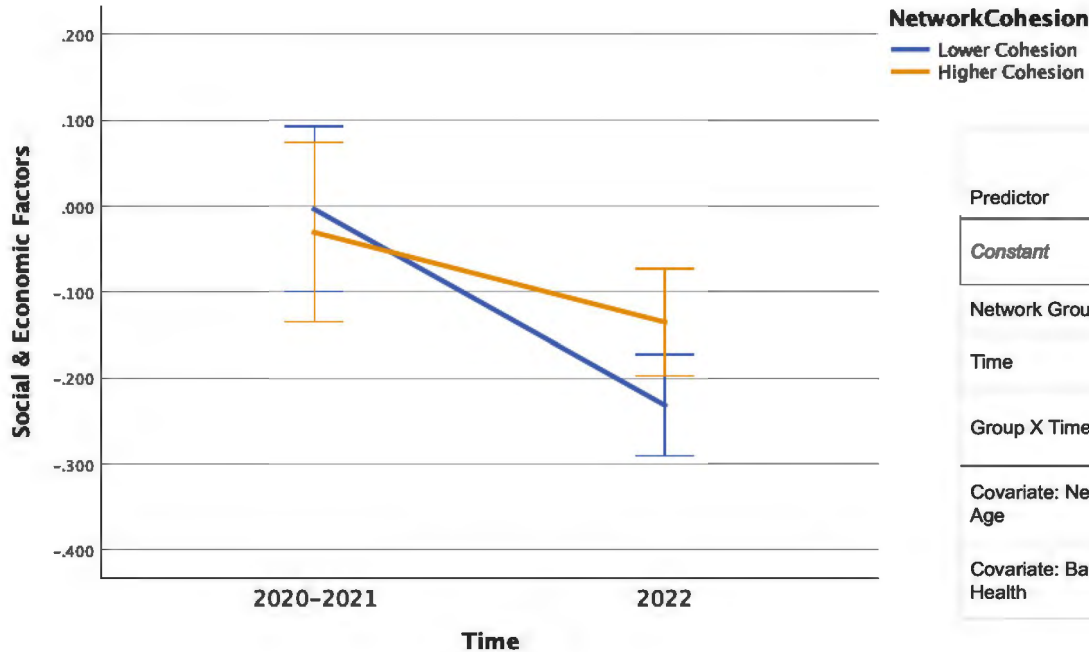
Health Behaviors



Linear Regression Results

Predictor	Coefficient	Standard Error	Wald Chi-Square	df	p-value
<i>Constant</i>	-.106	.03	8.29	1	.004
Network Group	.095	0.03	8.02	1	.005
Time	.047	0.01	10.93	1	<.001
Group X Time (DiD)	-.062	0.03	4.68	1	.031
Covariate: Network Age	.001	0.00	4.47	1	.034
Covariate: Baseline Health	.131	0.02	34.36	1	<.001

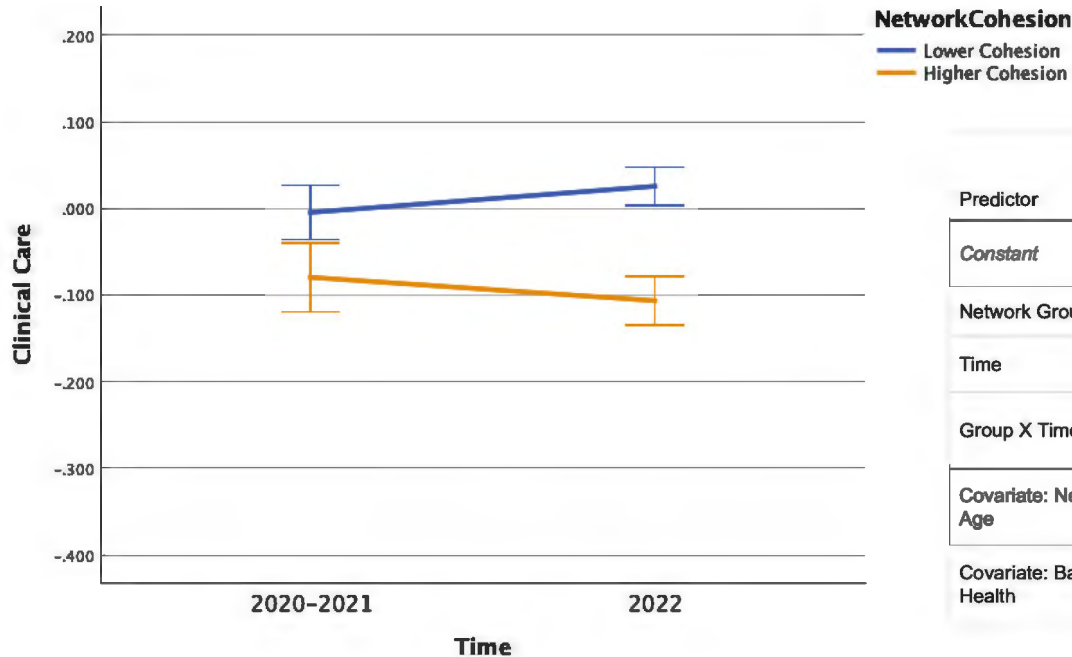
Social & Economic Factors



Linear Regression Results

Predictor	Coefficient	Standard Error	Wald Chi-Square	df	p-value
<i>Constant</i>	-0.30	.071	11.75	1	<0.001
Network Group	.025	0.06	3.18	1	0.075
Time	.260	0.04	86.80	1	<.001
Group X Time (DiD)	-.181	0.06	8.43	1	0.004
Covariate: Network Age	.005	0.00	7.06	1	.008
Covariate: Baseline Health	.383	0.05	32.38	1	<.001

Clinical Care



Linear Regression Results

Predictor	Coefficient	Standard Error	Wald Chi-Square	df	p-value
<i>Constant</i>	-.08	.02	3.32	1	.072
Network Group	.064	.02	7.40	1	.077
Time	-.030	.01	4.65	1	.031
Group X Time (DiD)	.057	.02	6.25	1	.011
Covariate: Network Age	-.001	.00	2.31	1	.139
Covariate: Baseline Health	.026	.02	1.31	1	.252

Conclusions

Conclusions

Tech-Enabled Community Resilience

- This study examined the relationship between social care network cohesion and community-level health factors, hypothesizing that **stronger, more interconnected networks positively affect these factors.**
- **Social care networks are key to community resilience,** yet little evidence suggests that collaboration between health care and non-health care organizations improves health outcomes.
- A difference-in-difference analysis found that **network cohesion was a significant predictor of community-level health factor changes, mitigating the negative effects of COVID-19.**

Conclusions

Tech-Enabled Community Resilience

- **Network analysis is better suited to quantifying resilience in a community ecosystem** and allows for a better understanding of what influences outcomes at the community-level.
- **Community resilience is a dynamic process** that describes a network of adaptive capacities that impact human society and allow it to adapt after adversity and take advantage of opportunities (Garstka & Kennedy, 2023; Norris et al, 2008).

From here, we can use a structured ecosystem approach to identify and test interventions that more **effectively enhance community resilience and optimize impact.**

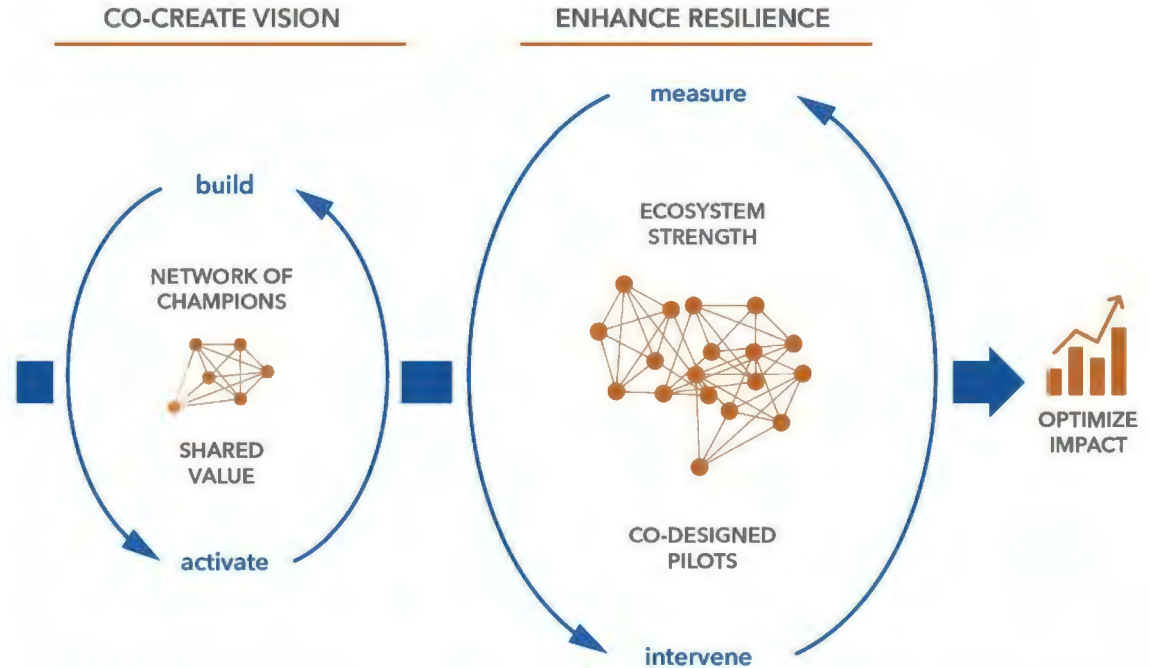
This is Tech-Enabled Community Resilience.

Tech-Enabled Community Resilience

The Model

Our **social innovation model** provides a foundational **dynamic ecosystem** approach to **enhancing resilience** and **optimizing impact and equity for all**

(Kennedy, Garstka, & Bonnet, 2024)





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