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Characterizing CVI Street Outreach Participants and Service Dosage: Implications for Measurement and Evaluation

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Abstract

Community violence intervention street outreach (CVI-SO) strategies are growing in popularity as non-punitive approaches to solving the public health problem of community gun violence. Evidence on the effectiveness of CVI-SO on rates of violence is mixed and faces challenges due to concerns with documentation and data privacy, intentional selection bias in program design, and variation in participant risk and needs. Effective evaluation requires methods that accurately capture the scope and delivery of services, starting with a greater understanding of the services CVI participants receive and how they vary based on individual characteristics. This study explores the services that participants received from a coalition of Chicago CVI organizations from 2017-2023. Considering administrative and programmatic data from over 4,000 participants' nearly 200,000 interactions with providers, the researchers examine patterns in demographics, network-based risk factors, and service provision and dosage. They then use descriptive and latent class analyses to characterize the "typical" participant in Chicago. Results show that CVI work relies heavily on long-term mentoring relationships to change individual behavior. Service patterns show that latent groups exist with varying dosage: Higher dosage participants with higher risk for gun violence receive more frequent contacts over longer periods, demonstrating how organizations adjust their approach based on participant needs. Classes that primarily receive behavioral or workforce-related services emerge, demonstrating a relationship to risk that becomes less clear over time. Findings underscore the need for evaluation frameworks that capture both the strategic variation in service delivery and the multiple pathways through which CVI programs influence participant outcomes.

Introduction

Community violence intervention (CVI) strategies have risen in prominence in the past decade due to a reconceptualization of gun violence as a public health issue and an active search for non-punitive interventions.[1,2] CVIs are community-driven and designed to engage those at highest risk of involvement in gun violence through direct outreach, intervention and prevention, and wraparound services.[3] At the core of many CVI efforts is the practice of *street outreach* where trusted neighborhood experts use their credibility and lived experience to intervene in conflicts and build peace. Outreach workers aim to reduce gun violence by engaging small networks of high-risk individuals, quelling imminent threats, and connecting participants to life-saving resources and services.[4]

Government investment in CVI increased dramatically following 2021's historic rise in gun violence, with over $5 billion from the American Rescue Plan Act and additional $250 million in support from the Bipartisan Safer Communities Act. Emerging CVI research suggests that these recent investments appear to be showing similar results as prior research: some programs demonstrate promising reductions in violence, others find limited or no effects.[5–9]

Impact variation across participants and contexts is common in many interventions, including education, medicine, and social services. For CVI street outreach (CVI-SO) programs, some of this variation likely stems from how we measure and evaluate the programs themselves. Current evaluations typically reduce CVI to yes/no measures: either a community has CVI or it doesn't, either individuals get services or they don't.[8,10,11] For instance, a recent study of over 1,500 outreach participants in Chicago classified participation in an 18-month intensive program by first-day attendance alone (with a take-up rate of 55%).[9] Such research limitations mischaracterize CVI programs and the work they do, ignoring crucial variation in both delivery and participant needs.

Effective CVI evaluation requires research techniques that accurately capture the scope and delivery of services, aligning methods and metrics with the on-the-ground work.[12] CVI is anything but uniform, operating at community, group, and individual levels and extending far beyond efforts to quell violent disputes. Further, outreach workers navigate variation in participant risk and needs. Some participants are actively involved in violent conflicts requiring daily crisis intervention, while others are peripheral actors needing preventive support. This spectrum of involvement demands different service combinations - from crisis response to employment assistance, housing, counseling, and education. Outreach workers calibrate both service type and intensity based on individual risk, community context, immediate group dynamics, and participant readiness for change.[13]

Such complex and dynamic work generates measurement challenges. First, CVI organizations rarely employ standardized recruitment criteria. Instead, workers assess risk and "readiness" through their deep community knowledge.[13] Outreach workers can spend months building relationships before a participant formally enrolls in a program, creating a selection bias for participants considered "ready" because they were deemed more likely to "succeed." This process also generates a measurement gap as the pre-enrollment work goes unrecorded.

Second, even after enrollment, imprecise treatment metrics fail to capture the strategic variation in service intensity across participants, failing to account for the possibility of any sort of dosage response among participants of different risk levels or backgrounds. Research in adjacent domains shows dosage response, including interventions aimed at reducing recidivism.[14–16] To our knowledge, only one prior study examines individual program dosage in CVI, finding reduced arrest likelihood only among participants completing all program stages.[5] As the field matures, practitioners and researchers are increasingly asking about "critical dosage" - what type and intensity of programming different participants need to reduce violence involvement.

This paper takes a step toward addressing these measurement challenges by analyzing detailed service data among a collaborative of CVI organizations in Chicago, IL. Using records of over 4,000 participants and 200,000 service interactions from July 2017- March 2023, we examine patterns in participant characteristics, risk factors, and service delivery. We combine social network analysis to estimate violence risk, qualitative coding to categorize service types, and latent class analysis to identify distinct participant profiles. Our objective is to examine the types of participants served by CVI programs as well as patterns of program provision and dosage, i.e., how service type, intensity, and duration vary across participants and risk levels. This research employs a community-engaged approach, developed and refined through ongoing partnership with CP4P, ensuring methods align with both social science rigor and community partners' lived experiences.[17,18]

Methods

Setting and Context

CVI-SO has grown nationwide since 2016. By March of 2023, CVI-SO organizations had some coverage in 59 out of 77 Chicago community areas, dominated by three primary strategies: READI Chicago, Chicago CRED, and Communities Partnering 4 Peace (CP4P; **Figure 1**). READI Chicago and Chicago CRED operate structured, phased programming with clear benchmarks and designated services to track progress. Evaluations of both have reported significant reductions in participants' likelihood of arrest for violent crimes relative to comparisons.[5,9] The structuredness of both program models facilitates research design for individual-level impact evaluations, as programming is regimented, and participant progress is clearly tracked. CP4P, the focus of this study, is comprised of several different CVI organizations operating CVI-SO services in a more *ad hoc* manner to meet the hyper-local needs of their communities.

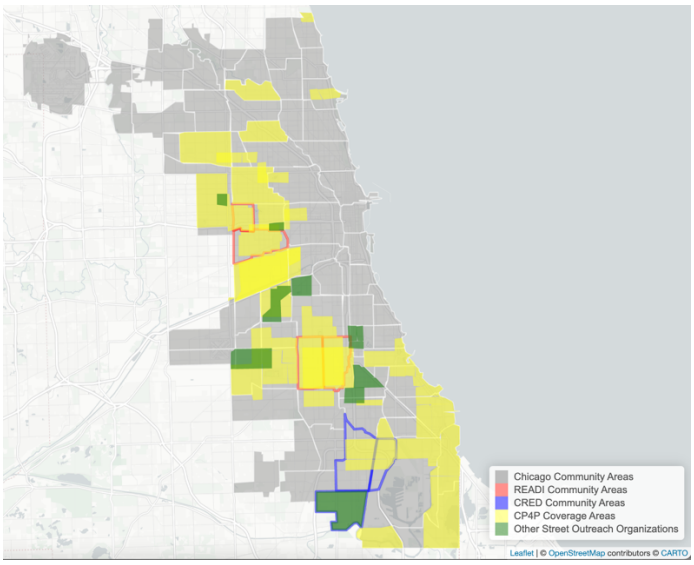

Figure 1: Map of CVI organizations in Chicago in 2023. CVI organizations had coverage in 59 out of Chicago's 77 community areas by 2023. CP4P coverage areas are highlighted in yellow, with additional CVI strategies' coverage areas outlined in red, blue, and green.

In response to a spike in gun violence in 2016, several Chicago CVI organizations came together as CP4P to coordinate their activities towards a common goal: reduce gun violence among individuals who are most likely to be involved in neighborhood disputes and group conflicts.[19] CP4P's efforts include mediating street group conflicts, "canvassing" neighborhood streets to build relationships and recruit participants, and supporting victims and their loved ones through the immediate aftermath of shootings. Organizations provide participants with direct services such as legal advocacy, employment support, educational opportunities, and trauma-informed behavioral health counseling. The collaborative expanded from eight organizations in 2017 to 15 organizations in 28 different neighborhoods by 2023. By January of 2023, CP4P had 246 CVI staff employed throughout Chicago.

While CP4P demonstrates promising descriptive reductions in community gun violence,[19] a primary challenge to evaluating the impact of services on participants is its multi-site and multi-organizational nature. Participants receive different types of services (from employment and education to recreational activities and mental health support), through a variety of methods (in person, in groups, over the phone, through social media or text messages), for an individualized amount of time (from one contact with an organization through sustained contact over several years). Because the types, amounts, and methods of service delivery vary across organizations and individuals, CP4P participants are difficult to classify for the purposes of individual-level impact evaluation.

Data Matching and Cleaning

Data included participants from ten organizations who were active in programming from July 2017 through March 2023. A quarterly process of data matching—which involves merging separate data sets that lack a common unique identifier by finding patterns among names, birth

dates, and other demographic variables—connected participants' programming data to administrative records provided by the Chicago Police Department (CPD). Records included arrests and shooting victimizations going back to 1999 and were anonymized during matching. Around 55% of participants were matched to records, indicating that just over half were either arrested or victimized in a shooting prior to beginning programming. After the data matching process, we harmonized variables and combined observations across organizations, resulting in datasets that uniquely identified participants, their demographic data, the services they received, and other programming characteristics.

Estimating Baseline Gun Violence Risk

CVI-SOs focus on a subset of a neighborhood's population—those at highest risk of involvement in gun violence—and rely on their local knowledge to identify and engage potential participants.[13,20] CVI organizations rarely employ formal risk assessment tools, instead relying on outreach workers' deep understanding of local dynamics and relationships. Risk, however, is not uniformly distributed among outreach participants. Outreach workers must assess varying risk levels to adjust their responses and service provision. For example, in some instances, outreach workers must respond immediately to a recent shooting to stymie retaliation while in others they work to mediate disputes before they lead to violence.

To quantify variation in participant risk in a way that aligns with outreach practices, we drew on established network science approaches to gun violence. Research shows that individuals within close network proximity to recent gunshot victims face elevated risk of victimization themselves as violence often cascades through social networks.[21–23] Using this insight, we constructed a "high-risk network" by identifying all individuals within two co-arrest ties of recent shooting victims in each community, effectively mapping the population most relevant for outreach services. For this analysis, CP4P participants within these high-risk networks were considered at elevated baseline risk and, as such, more likely to be on the CVI organization's radar. While this approach cannot capture all dimensions of risk that outreach workers must consider, it provides a measurable indicator of risk variation that reflects the networked nature of gun violence and aligns with the population outreach workers engage.[20,24]

Defining Service Categories

After each contact with a program participant, street outreach workers and case managers recorded the primary focus of the interaction (e.g. mentoring, legal services, job training, etc.) and its method of delivery (e.g. in-person, email, phone call, virtual call, group activity). Documentation protocol varies across organizations, ranging from structured checkboxes and drop-down menus to free-form text descriptions, creating challenges for systematic analysis. This variation, combined with non-standardized service definitions across organizations, required developing consistent categorization schemes across all ten organizations.

We applied qualitative coding to determine the common service categories provided across and within organizations. First, we used character string pattern recognition to group

190,000 entries for services provided to street outreach participants into common categories, resulting in 13 categories that grouped together in the data after dropping contacts recorded as "unsuccessful". Next, three coders considered the entries that did not fit cleanly into the identified categories, independently categorizing the entries before conferring to compare and resolve differences. The coders elevated the unresolved entries to the co-authors, who made final category designations based on consultation with CP4P implementers and knowledge of the programs' operations. Ultimately, all entries were categorized under one of 13 unique contact categories: mentoring, case management, employment, community events, legal, family, education, mental/behavioral/physical health, crisis/conflict resolution, housing, immediate needs, transportation, and unclear. Descriptions and examples for each category are provided **Table S1**. In several instances, multiple categories of focus were included in a single entry. These cases were recorded as one overall contact with one count for each category of service provided during the single interaction with the participant.

Calculating Adjusted Tenure

Participants are often hard to reach by traditional systems and will occasionally drop out of contact with organizations, resulting in inconsistent and non-linear engagement with providers. To calculate participant tenure, we subtracted the date of the first recorded contact from the date of the most recently recorded contact. However, many participants had infrequent contacts with service organizations over long periods of time, which biased the total tenure. To calculate the amount of time that participants were actively in contact with partner organizations and receiving services (referred to as "adjusted tenure"), we considered a gap in services as 30 days or more in between recorded contacts (informed by CP4P staff) and subtracted out the total number of gap days from the participant's overall tenure. For example, if a participant was in contact with a service organization for 200 days, but had three gaps of 31, 40, and 50 days in between contacts, that participant's adjusted tenure would be 79 days.

Latent Class Analysis and Logistic Regression

We next applied latent class analysis (LCA) to identify groups of individuals based on similarities between the services they received. LCA is a "person-centric" clustering approach that helps identify unobserved but potentially "latent" subgroups within a larger population.[25–29] The method is a form of mixture modeling, and tests whether an observed population distribution can be decomposed into a "mixture" of unobserved but latent distributions. LCA often operates and iterates through the maximum-likelihood estimation (MLE) algorithm to estimate the class probabilities to which individuals are assigned, allowing researchers to examine the classes for their qualitative differences.[29] LCA may rely on evaluation metrics such as the Akaike information criterion (AIC), Bayesian information criterion (BIC), Pearson Chi-square goodness of fit statistic, and the likelihood ratio/deviance statistic to determine the most appropriate number of classes to use.[28] Indicators, i.e., the variables of an LCA model, can be formulated as either dichotomous (binary) or polytomous (multi-category).

To assess whether subgroups might subsist within the broader population of CP4P participants, we used the poLCA package in R[30] on participants who have undergone more than one day of programming (adjusting for gaps in tenure) based on dichotomous indicator variables of whether they received a given service category ("yes" they received at least one service in that category or "no" they did not). Then, given the importance of selecting individuals for programming who are at high risk of gun violence, we used logistic regression to investigate participants' predicted latent class in relation to confounders—race/ethnicity, gender, and tenure—and their baseline estimation of risk, as conceptualized through their presence in our derived high-risk network for Chicago. To test the hypothesis that the length of time in programming may affect an individual's placement into a latent class, we interacted the predicted latent class variable with the adjusted tenure variable. **Equation 1** shows our logistic regression formulation with covariates, where P represents the probability that an individual shows up in the high-risk network prior to programming, β_0 represents the intercept, and each β_n for $n = \{1, 2, 3, 4, 5\}$ represents the corresponding covariate coefficient estimate.

$$log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 class + \beta_2 tenure_{adj} + \beta_3 gender + \beta_4 race + \beta_5 (class \times tenure_{adj}) \quad (1)$$

Results

Single-Day Participants

631 participants were in contact with providers for only a single day. About a third of these participants identified as female, 90% identified as Black, and most contacts happened in person, discussing mentoring and employment (**Figures S2-S4**). How single-day participants fit into the profile of a "typical" outreach participant is unclear. Single-day participants may represent an important dimension of outreach work, such as canvassing, participation at community events, or other trust-building or information-gathering interactions with outreach staff. Unfortunately, our data do not allow for further investigation; our analyses include only participants that have at least two days of tenure.

CP4P Participant Demographics and Services Profile

During the study period, CP4P served 3,665 unique participants with at least two days of contact. 59.8% identified as Black or African American men, 12.9% as Black or African American women, and 17.5% identified as Hispanic or Latino men. Outreach staff provided 174,478 unique contacts with an average of two types of services provided per contact to participants (e.g. employment and education services provided in one interaction), delivering 335,858 services. Organizations provided 68,547 in-person contacts with participants, 66,484 remote contacts, and 20,800 group-based contacts. Mentoring was the most common type of service provided, with 3,304 of 3,665 participants receiving at least one mentoring contact. Employment and case management were the second and third most common (**Figure 2**). More information on the types of services provided by each organization can be found in the Supplemental Materials (**Table S2**).

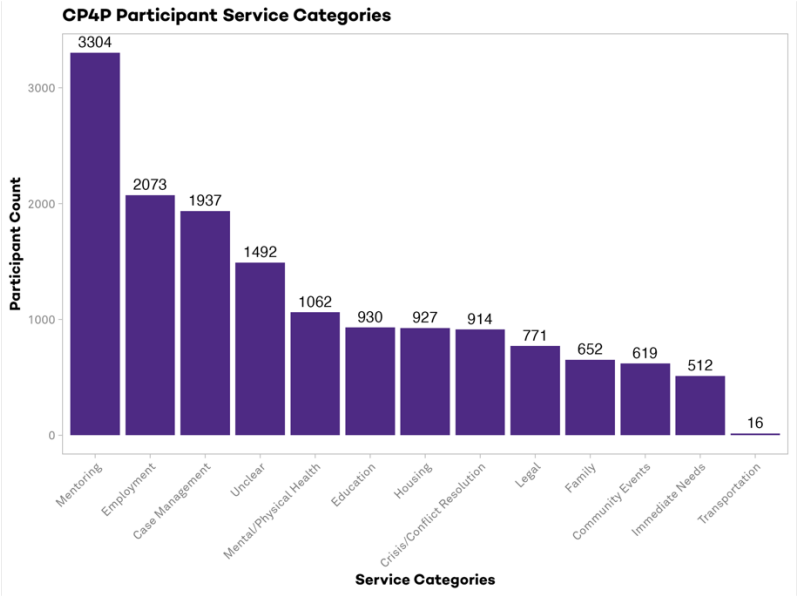

Figure 2: Number of CP4P participants receiving at least one contact for each service category (n = 3,665). Nearly all CP4P participants received at least one mentoring contact, followed by employment and case management.

Figure 3 displays the distribution of services received in all 13 categories. CP4P participants received, on average, about 47 individual contacts (median = 22) and were on caseloads for an average of 240 days. On average, participants received 48 mentoring, 12 employment, eight case management, and four education services during their tenure.

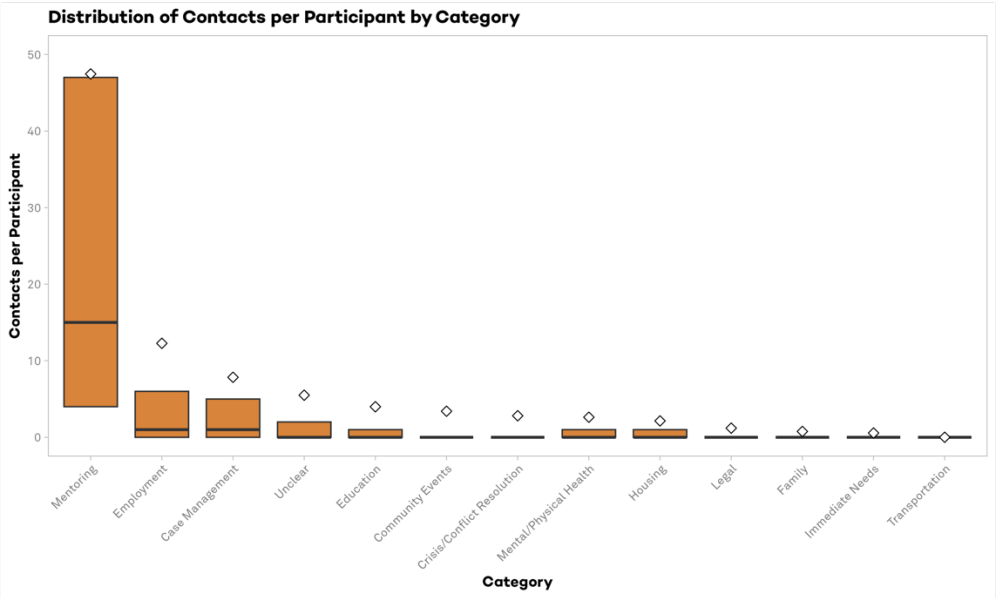

Figure 3: Distribution of contact counts per CP4P participant. White diamonds represent the mean number of contacts per participant in each category, black lines represent median and quartiles. On average, participants receive 47.8 mentoring contacts (median = 15) and 12.3 employment (median = 1). All other contact categories have medians of 0.

Demographics and Services Profile for Participants with Arrest History (Matched Participants)

55% (N = 2,018) of participants were matched to administrative records (henceforth referred to as matched participants).[a] 62.5% identified as Black or African American men, 10.6% Black or African American women, and 19.1% as Hispanic or Latino men. Participants were just under 30 years old and averaged 10.9 arrests, including 0.67 arrests for violent crimes at the time of services with CP4P. Pre-enrollment rates of shooting victimizations were far above city levels (**Figure S1**), with participants averaging 0.23 gunshot victimizations before starting services. On average, participants had about 5.1 years in between their most recent arrest and first contact with CP4P. Over 67% of total service contacts during the study period were received by matched participants.

Mentoring was the most common type of service for matched participants, with 1,828 of 2,018 total participants receiving at least one mentoring contact (**Figure 4**). Second-most common was employment followed by case management. Matched participants averaged more contacts over a longer period relative to the larger participant sample, with 58 contacts (median 27) over approximately 288 days.

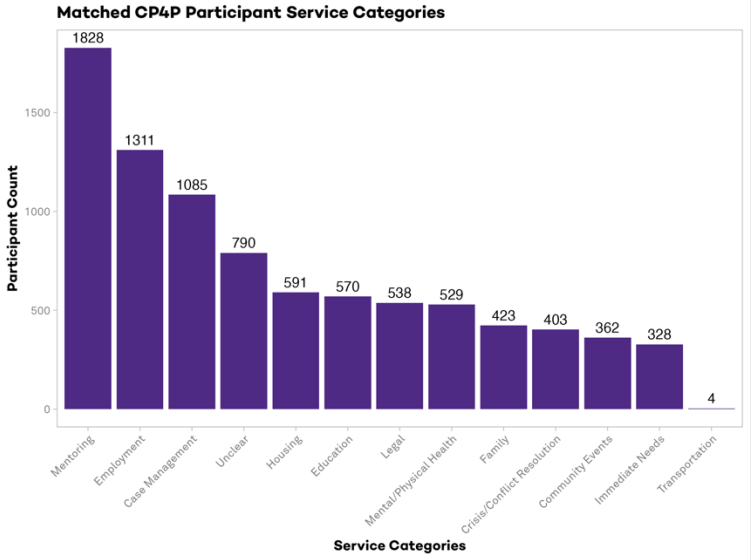

Figure 4: Number of matched participants receiving at least one contact in each category (n = 2,018). Participants that were matched to CPD records largely received mentoring-, employment, and case management-focused services from CP4P providers. These participants had 117,547 total contacts with service providers (67.37% of all contacts), receiving 219,232 services.

[a] The remaining 1,647 individuals (i.e., unmatched) either did not have an arrest history at the time of analysis or had incomplete information on which to match to administrative records. Unmatched participants were about 21% female and 73% Black, received mentoring as the primary form of service, and had an average adjusted tenure of 182 days **(Figures S5-S7).** Because CP4P did not provide ages or years of birth for their participants, we only have age estimations on this matched subset.

Approximately 22% (N = 442) of matched participants were located within the citywide high-risk network before the year they first received services. Participants in the high-risk network averaged even more contacts with service providers than their non-high risk matched peers, receiving 73 contacts (median 37) each over 375 days (**Figure 5**). Though participants in the highest-risk network represent only 12% of all participants, they received 19% of all contacts made by organizations during the study period. High-risk network participants are, on average, about six years younger than the larger sample of matched participants (**Figure 6**). These participants also have more pre-enrollment arrests (mean 13.3) (**Figure 7**). High-risk network participants receive their first contact with service providers within about 19 months of an arrest, which is considerably sooner than other matched participants. High-risk network participants also enroll with service providers within six months of a victimization, on average, compared to about 18 months for the other matched participants (**Figure 8**).

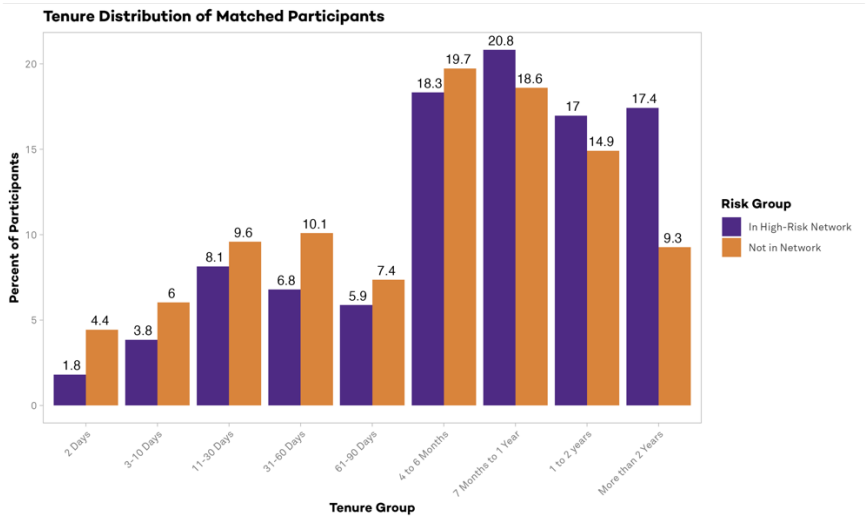

Figure 5: Tenure distribution of matched participants by presence in the high-risk network. Participants in the city-wide high-risk network (n = 442) were in contact with CP4P service providers for an average of 375 days. Matched participants not in the high-risk network (n = 1,386) had an average tenure of 288 days.

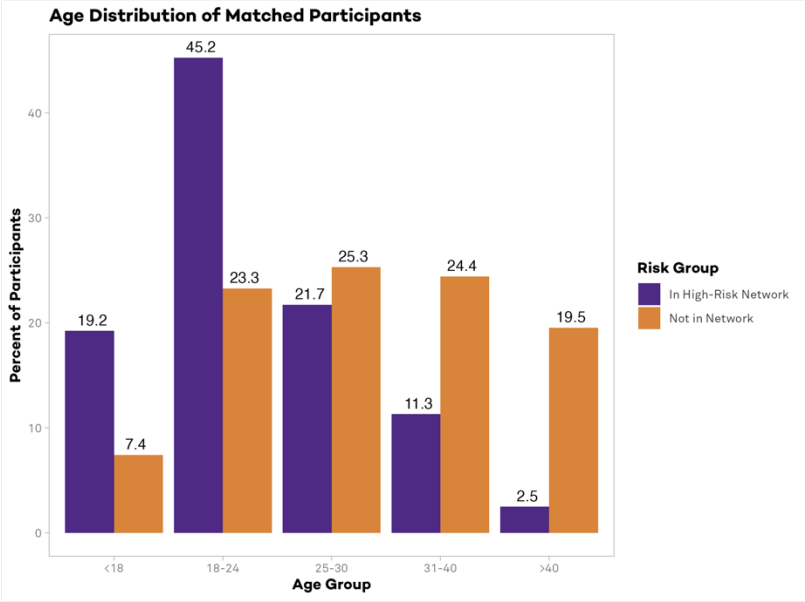

Figure 6: Age distribution of matched participants by presence in the high-risk network. Participants in the city-wide high-risk network (n = 442) had their first contact with CP4P providers at an average of 23.4 years old. Matched participants not in the high-risk network (n = 1,386) had an average age of 31.2 years at first contact with providers.

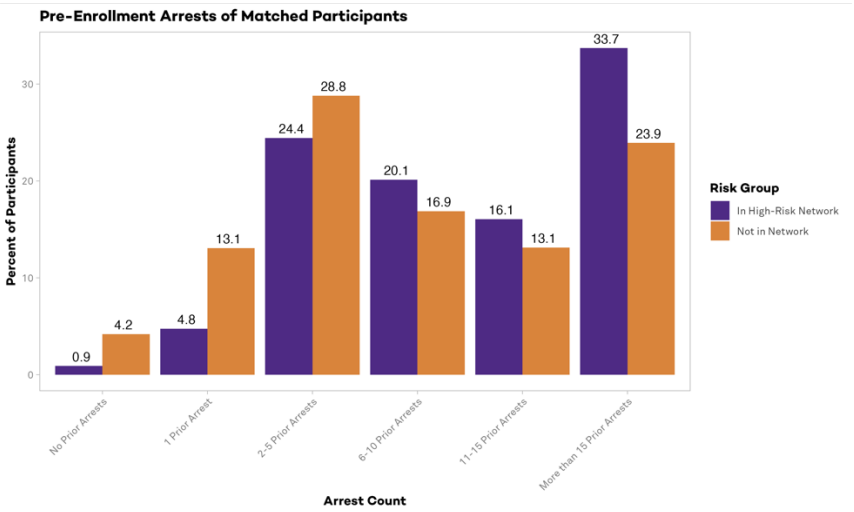

Figure 7: Pre-enrollment arrest count distribution of matched participants by presence in the high-risk network. Participants in the city-wide high-risk network (n = 442) averaged 13.3 arrests before enrolling in programming with CP4P. Matched participants not in the high-risk network (n = 1,386) had an average of 10.3 arrests before first contact with providers.

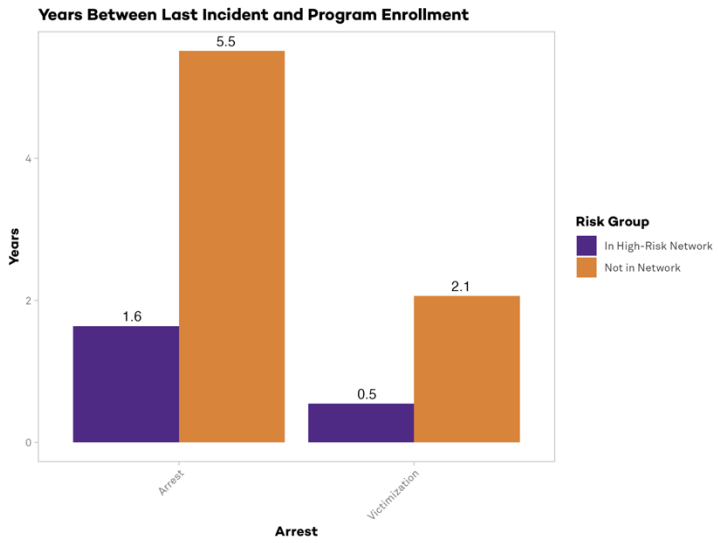

Figure 8: Average time between last event and first contact with CP4P providers. Participants in the city- wide high-risk network (n = 442) averaged 1.6 years between their most recent arrest and first recorded contact with a CP4P provider, and 0.5 years between most recent gunshot victimization and enrollment. Matched participants not in the high-risk network (n = 1,386) averaged 5.5 years and 2.1 years between their most recent arrest and victimization, respectively, and first contact with CP4P.

Latent Class Analysis

To prepare the LCA, we first ran a Chi-squared test of independence between all possible pairs of service category indicators to determine which indicators were highly correlated and could be removed from, or potentially modified for, the analysis. Due to high correlations between transportation and other services, the transportation, housing, and immediate needs service categories were aggregated into a new "material needs" category. Similarly, the mentoring and case management categories were highly correlated with nearly all other categories and were removed from the LCA. Despite high correlations between the crisis/conflict resolution and material needs categories and the employment and mental/physical health categories, all were deemed too important to be removed from the analysis. A table of pairwise Chi-square values for all original categories is provided in **Table S2**. Sensitivity analyses that iteratively removed those variables showed that excluding any of those service categories only marginally improved the model fit but led to less interpretable classes. The final eight service categories include community events, crisis/conflict resolution, education, employment, family, legal, material needs, and mental/physical Health.

A four-class model created distinct, cohesive classes (**Figure 9**). After four classes, all evaluation metrics only marginally improve with the next subsequent class, and individuals from one class splinter into new classes without moving into pre-existing classes (**Figure S8**). Individuals in Class 1 (n = 1,166) have a higher likelihood to receive services in two categories: employment and material needs. These "Workforce Participants" make up 32% of participants in this analysis. Individuals in Class 2 (n = 571) have high probabilities of receiving services across all categories. These "High Dosage Participants" make up 16% of participants and are proportionately

more Hispanic / Latino and less female than the other three classes (**Table 1**). The High Dosage class also contains proportionately more individuals in the highest-risk network (20.1% of this group) relative to the other three classes. Class 3 (n = 346), the "Behavioral Participants," is the smallest class, making up just 9% of participants. Behavioral Participants are most likely to receive services in crisis/conflict resolution and mental/physical health. Finally, individuals in Class 4 (n = 1,582) have low likelihoods across all services. These "Low Dosage Participants" make up 43% of participants. A summary of the classes is given in **Table 1** and demographic and services details are provided in **Figures S9-S10**.

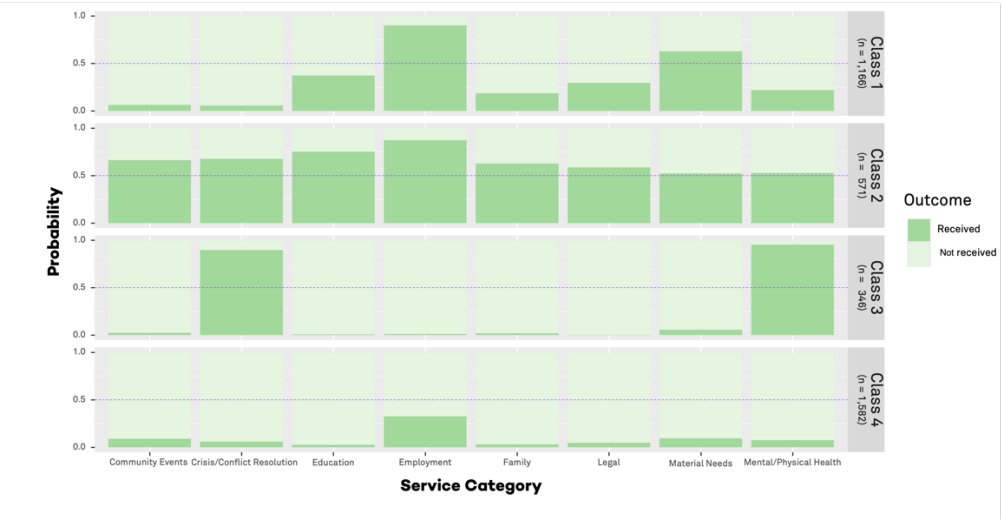

Figure 9: Estimated class-conditional response probabilities of the latent class analysis. The binary outcomes included "yes" a participant received service(s) in that category or "no" if not. The height of the bars correspond to their estimated-class conditional probability of "yes" or "no," thus, bars that are closer to 0 represent low likelihoods and bars that are closer to 1 represent high likelihoods.

Logistic regression results show how tenure in programming (adjusted for gaps) and other demographic confounders may mediate the likelihood that individuals in that class were found in the citywide high-risk network—a powerful proxy for the need for intervention—before beginning programming. **Table 2** shows the odds ratios of the logistic regression and their confidence intervals.

The main effect of predicted class (depending on adjusted tenure) as well as the model's covariates (gender and race/ethnicity) are nearly all significant on the outcome of a participant's presence in the high-risk network prior to programming when compared to the reference group. The baseline reference groups for the logistic regression's categorical variables include Class 4 (the Low Dosage Participants), identifying as female, and identifying as Hispanic/Latino. Individuals who have longer tenure (OR = 1.0019; 95% CI [1.0013 – 1.0025]) and identify as male (OR = 4.63; 95% CI [2.94 – 7.79]) are strongly associated with being in the high-risk network, holding all other variables constant. Being a High Dosage Participant has a strong positive association with the high-risk outcome (OR = 1.67; 95% CI [1.13 – 2.52]) when compared to the Low Dosage Participants, holding all other variables constant. The Class 3 (Behavioral Participants), when holding all other

variables constant, were not deemed to have a significant relationship with appearing in the high-risk network before programming.

Class, however, dampens the positive association between tenure and presence in the high-risk network. Negative class and tenure interaction coefficient estimates indicate that the longer a participant stayed in programming, the less likely they were to be in the high-risk network. Put another way, the positive relationship between tenure and having been in the high risk network (i.e., the longer their tenure, the higher the likelihood they were in the high-risk network) is weaker for individuals in Class 1 (Workforce Participants; OR = 0.999; 95% CI [0.998, 1.000]) and Class 2 (High Dosage Participants; OR = 0.999; 95% CI [0.998, 1.000]), and weakest for individuals in Class 3 (Behavioral Participants; OR = 0.994; 95% CI [0.990, 1.000]) compared to Low Dosage Participants.

Discussion

This study's analysis of 3,665 CVI-SO participants provides a comprehensive examination of how CVI-SO services are delivered on the ground. Results show that CVI-SOs provide an array of services to a population of varying levels of risk and needs. Organizations appear to successfully adjust service delivery based on risk levels, as high-risk participants—those within two co-arrest ties of recent gunshot victims—receive more frequent contacts over longer periods compared to other participants. High-risk participants enter services at younger ages and receive nearly 20% of all service contacts despite representing only 12% of participants. Latent class analysis bolstered these findings, identifying four distinct participant profiles—Workforce, High Dosage, Behavioral, and Low Dosage—each receiving different combinations and intensities of services. Results from logistic regression suggest that the types of services individuals receive are reflective of their initial risk designation, but the relationship between initial risk and tenure for higher dosage classes erodes over time, indicating that risk may decrease but will certainly need to be reassessed as a participant progresses. This variation in service delivery suggests that organizations are appropriately calibrating their response to participant needs rather than applying a one-size-fits-all approach.

The practice of mentoring underscores the dynamic nature of service provision as well as the difficulty in measuring it. Received by over 90% of participants, mentoring is a highly interpersonal dimension of violence prevention and emphasizes how relationship-building serves as the primary mechanism for inspiring behavioral change.[13,31–33] Outreach workers report that mentoring "helps [participants] see positively" and "get out of their norms" so they can become ready for change. This mentoring approach is particularly crucial for participants who may be reluctant or ambivalent about changing risky behaviors. Yet, mentoring itself, let alone its impact on outcomes of interest, can be quite elusive to measure.

Our findings advance research by documenting how CVI programs operate as complex, dynamic interventions rather than uniform treatments. Our analysis reveals that dosage in CVI work is not simply participation versus non-participation, but rather a fluid combination of service types and intensities that outreach workers fluidly adjust based on participant risk and needs.

Frontline staff make sophisticated assessments of participant risk and readiness, strategically varying both the type and intensity of services—from crisis intervention to employment support—to match changing circumstances.[20] This adaptive approach to service delivery represents a fundamental feature of CVI work that has been overlooked—and gone unmeasured—in previous evaluations focused on binary treatment measures. These nuanced assessments, while crucial for effective intervention, create challenges for traditional evaluation approaches that rely on standardized metrics. Future evaluations must develop more sophisticated measurement approaches that can account for variation in both risk and service delivery.

Limitations

Several important limitations should be considered when interpreting these findings. First, while our data represents the most complete individual-level CVI-SO services dataset available, approximately 20% of services were coded as "unclear" due to inconsistent or incomplete documentation. This population itself might reflect an important part of CVI work; but we cannot make that assessment with current data. Missing information likely skews our understanding of service patterns and may disproportionately affect certain types of interactions, particularly informal contacts that build trust and relationships.

Second, documentation of outreach work faces challenges that affect both service delivery and evaluation. Managing caseloads of 15-20 participants and lacking provider-patient confidentiality protections, street outreach workers must carefully balance evaluation needs against potential risks to their credibility and effectiveness. Outreach trainers acknowledge this tension, simultaneously emphasizing that "if you don't document it, it didn't happen" while warning to "be careful how to log it because they can subpoena things for court." These tensions lead to strategic decisions about documentation that likely result in undercounting of services, particularly the informal interactions crucial for building trust and preventing violence.

Third, our ability to assess participant risk was limited to those with an adult arrest history in Chicago (55% of participants), potentially missing other forms of violence exposure or risk factors. The social network approach to measuring risk, while powerful, captures only one dimension of vulnerability to violence and may not fully reflect the nuanced risk assessments made by street outreach workers.

Fourth, the observational nature of this study limits causal inference about the relationship between service patterns and outcomes. While we observe patterns of risk levels and service intensity, we cannot determine whether these patterns reflect optimal service delivery or are driven by other factors such as participant availability or program capacity. However, the sorts of variation-capturing metrics we advance here could be added to quasi-experimental methods to explore the possibility of a causal relationship.

Finally, our analysis covers only one coalition of CVI-SO programs in Chicago. While CP4P represents a diverse set of organizations, findings may not generalize to other cities or program

models. Local context, including patterns of violence, community resources, and program implementation, likely influence both service delivery and participant engagement patterns.

Future Directions

The variation in service delivery patterns documented in this study, combined with the complex risk factors of participants, necessitates a fundamental shift in how we evaluate CVI and its impact. Our findings suggest the need for a multi-dimensional evaluation framework that encompasses several key domains of change. Such a framework should examine *individual-level* behavioral changes and mindset transformation, alongside economic outcomes related to employment and legitimate income. It must also consider participants' development of pro-social connections and community engagement, as well as their patterns of program engagement and service utilization. Crucially, these metrics should be risk-adjusted to account for participants' baseline exposure to violence, recognizing that maintaining non-involvement in violence among highest-risk participants may represent program success. Future work is needed to understand how risk varies dynamically before, during, and after contact with CVI programming, and how to properly model those dynamics for evaluating program outcomes.

Findings from this study point to several critical areas for future research. First, we need a better understanding of how participant "readiness" for programming influences service delivery and outcomes. Second, investigation of potential dosage effects—how different intensities of services affect outcomes for different risk profiles—could help optimize resource allocation. Finally, we need more sophisticated methods for measuring and evaluating the impact of relationship-building and informal interactions that form the foundation of outreach work.

This study indicates that CVI-SO programs operate more as a dynamic system of tailored interventions than as a standardized treatment. Effective evaluation must evolve to match this reality, developing methods that can capture both the complexity of service delivery and the nuanced ways programs influence participant outcomes.

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Table 1: Participant characteristics by latent class.

Class	N	Race (%)	Gender (%)	Adjusted Tenure (Median Days)	Total Contacts (Median)	High-Risk Network (%)
1	1,166	Black: 79.7% Latinx: 15.1% Other: 5.1%	Female: 20.1% Male: 76.0% NR: 3.9%	182.5	52	12.%
2	571	Black: 52.7% Latinx: 43.1% Other: 3.5%	Female: 11.6% Male: 85.3% NR: 3.2%	360	123	20.1%
3	346	Black: 88.7% Latinx: 3.5% Other: 7.8%	Female: 19.4% Male: 80.1% NR: 0.6%	137.5	81.5	4.6%
4	1,582	Black: 74.1% Latinx: 19.0% Other: 6.2%	Female: 15.0% Male: 81.1% NR: 3.9%	58	14	10.6%

Table 2. Odds ratios and confidence intervals of LCA variables.

	OR	**2.5%**	**97.5%**
(Intercept)	0.021	0.012	0.003
Class 2	1.699	1.132	2.523
Class 1	1.364	0.989	1.877
Class 3	1.002	0.452	2.042
Adjusted Tenure	1.001	1.001	1.003
Male	4.633	2.940	7.791
Non-Binary	0.000	*NA*	6.192e+24
Gender Not Reported	3.709	1.639	8.133
African American or Black	0.810	0.635	1.039
Race, Other	1.022	0.594	1.673
Class 2 x Adjusted Tenure	0.999	0.998	1.000*
Class 1 x Adjusted Tenure	0.999	0.998	1.000*
Class 3 x Adjusted Tenure	0.994	0.990	1.000*
*These values are slightly under 1 and are still statistically significant for at least p > 0.05.			

Characterizing CVI Street Outreach Participants and Service Dosage: Implications for Measurement and Evaluation

Supplemental Materials

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Susan Burtner
Andrew Papachristos

SUPPLEMENTAL MATERIALS

CP4P Organization Service Characteristics

The CP4P service organizations considered in this analysis varied in the categories of services they provided. Mentoring was the most provided service for eight of the ten organizations, with anywhere from 90% - 100% of their participants receiving at least one mentoring contact. All organizations provided case management services, and most organizations provided education- and employment-, related services to participants, as well as services for mental and physical health, family supports, and legal and housing assistance (**Table S2**). Critically, six of ten organizations reported services that were unable to be categorized for 60% or more of their participants, meaning that the service provided was not described clearly enough for researchers to be confident in its categorization.

Table S1. Services Dictionary and Examples

Category	**Definition**	**Example Entries**
Case Management	Services that involve working with a participant to set goals and connect them to services	"assisted with resources"; "check-in"; "coordinated care"
Community Event	Participants attending events in the community	"barbecue"; "community presentation"; "sports"; "light in the night"
Crisis / Conflict Resolution	Services that involve working with CVI staff to resolve conflicts, prevent violence after shootings, and assist participants through challenging times	"recent victim of violence"; "restorative justice peace circle"; "providing other non violent strategies for conflict resolution"
Education	Services that help participants access schooling and degree programs, tutoring, and other academic supports	"school registration"; "graduation"; "college/trade school coaching"; "starting a class for GED"
Employment	Services that help participants access or maintain employment, including job training and preparing applications	"job application"; "finding new employment"; "networking"; "job readiness"
Family	Services that involve participants' families; can include building stronger relationships with family members, involving families in programming, or intervening in family conflict	"assisted with a family situation"; "child-care resource assistance"; "working on better parenting skills"; "trying to get the brother to engaged being a participant"
Housing	Services that help participants acquire and/or maintain housing	"finding somewhere to live"; "housing/rental assistance"; "helped with housing"
Immediate Needs	Services that provide material and supportive assistance to	"helping with moving"; "funeral assistance"; "food";

	participants for meeting basic needs	“help with having clean clothes and food”
Legal	Services that help participants navigate the legal system	“expungement”; “legal system navigation/advocacy”; “court advocacy”; “background check”
Mental, Behavioral, or Physical Health	Services that support participants’ mental, behavioral, and physical health needs	“anger management impulse control”; “substance abuse”; “recovery planning”; “his health”
Mentoring	Interactions with outreach workers that support participants with shifting mindsets towards non-violence	“change attitudes towards use of violence”; “life choices”; “overcoming barriers”; “just to talk”; “relationship-building”; “supportive interaction”; “coaching”
Transportation	Financial or other assistance for participants’ transportation	“ride to the store”; “gave participant a ride”; “took to work”; “get him a bus card”
Unclear	Vague or ambiguous contact descriptions which could not be categorized	“assistance”; “was at house”; “training”; “information”; “death”

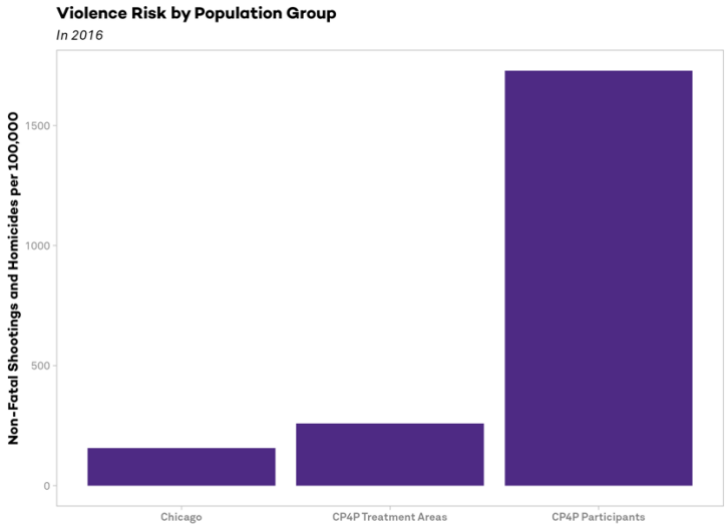

Figure S1: Relative risk of gunshot victimization for CP4P participants. At a victimization rate of 1728 per 100,000 residents, CP4P participants are at a 6.7x greater risk of gunshot victimization or homicide relative to individuals in their neighborhoods, and 11x greater relative to the citywide rate.

Table S2: Percent of participants at each CP4P organization receiving each service category.

	Case Management	Community Event	Crisis/Conflict Resolution	Education	Employment	Family	Housing	Immediate Needs	Legal	Mental, physical, behavioral health	Mentoring	Transportation	Unclear
A	59.1	29.1	26.7	62.4	90.9	26.7	34.5	10.3	35.8	30.9	99.7	0	7.8
B	86.0	0	0	26.3	78.0	0	35.5	0	2.2	24.2	4.4	0	86.0
C	80.0	2.5	83.2	0.7	3.9	0.9	4.1	4.8	0.9	80.2	94.7	3.7	59.8
D	81.6	0	0	16.7	65.3	14.6	28.0	43.7	35.6	2.8	90.6	0	80.9
E	39.3	58.5	33.6	48.0	49.8	43.5	11.5	14.8	33.4	23.3	97.2	0	41.5
F	82.2	73.3	75.6	84.4	91.1	64.4	64.4	51.1	68.9	73.3	100	0	60.0
G	55.4	0	51.8	0	0	3.6	7.2	14.5	0	39.8	81.9	0	91.6
H	9.5	2.4	0.4	0.8	5.1	2.0	3.2	5.5	2.4	1.6	94.5	0	69.6
I	33.1	15.5	18.3	24.4	78.9	18.7	40.5	9.6	20.4	30.0	96.2	0	9.9
J	82.6	1.5	0	10.6	18.2	9.1	0	0	14.4	1.5	98.5	0	0

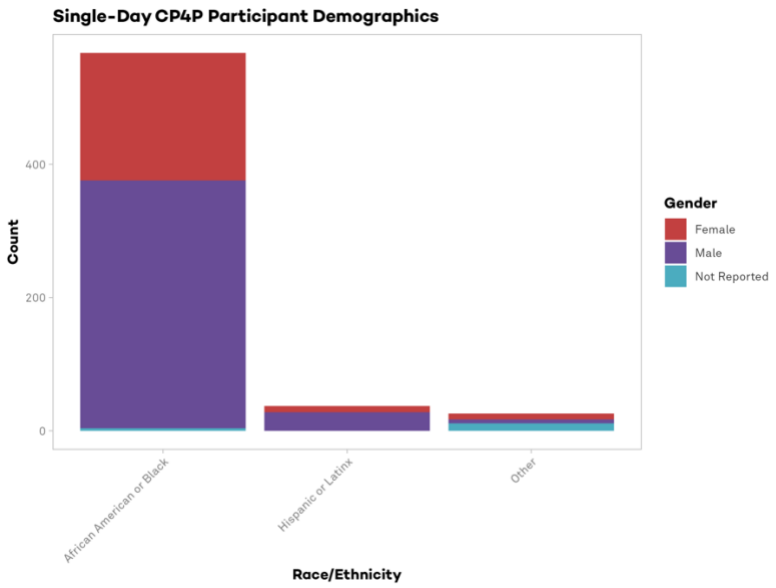

Figure S2: Gender and race of CP4P participants with a single day of contact with partner organizations (n = 631). 59% of single-day participants identify as Black men, 30.3% identify as Black women, 4.4% as Hispanic / Latinx men, and 1.4% as Hispanic / Latinx women.

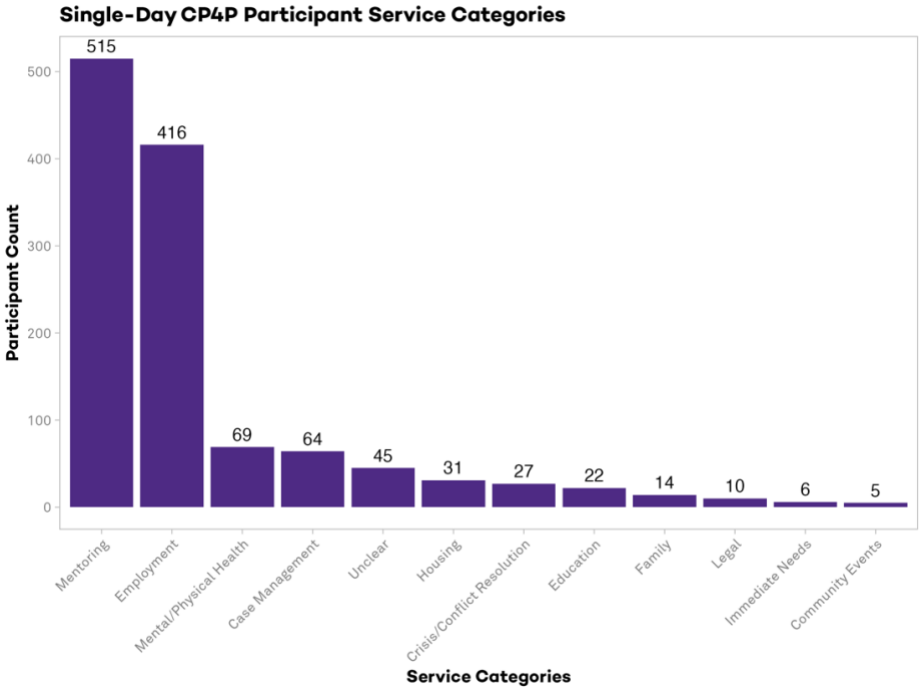

Figure S3: Number of single-day participants receiving at least one contact in each category (n = 631). Single-day participants largely received mentoring- and employment-focused services from CP4P providers. These participants had 733 total contacts with service providers, receiving 1861 services.

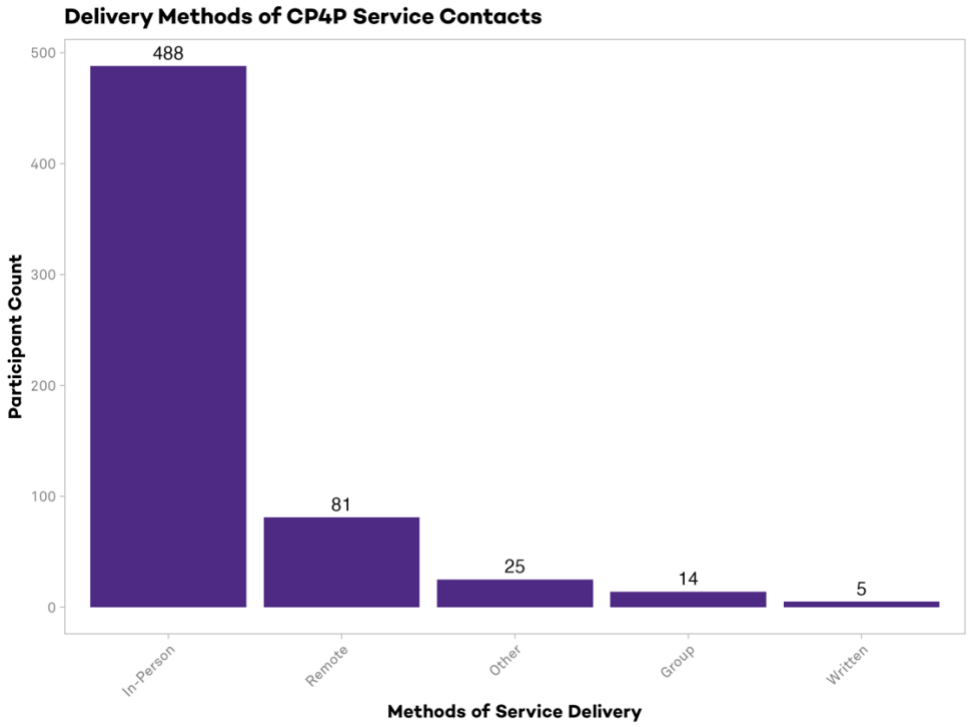

Figure S4: Delivery methods of service contacts for single-day participants (n = 631). Single-day participants received the majority of contacts in-person, which may represent meeting individuals at canvassing or other community events.

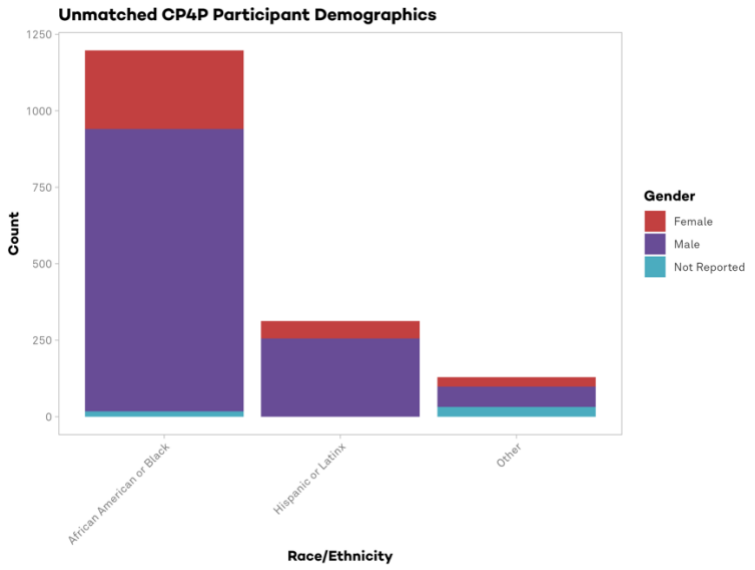

Figure S5: Gender and race of unmatched CP4P participants (n=1647). 56.4% of participants that could not be matched to CPD administrative records identify as Black men, 15.6% identify as Black women, 15.6% as Hispanic / Latinx men, and 3.5% as Hispanic / Latinx women.

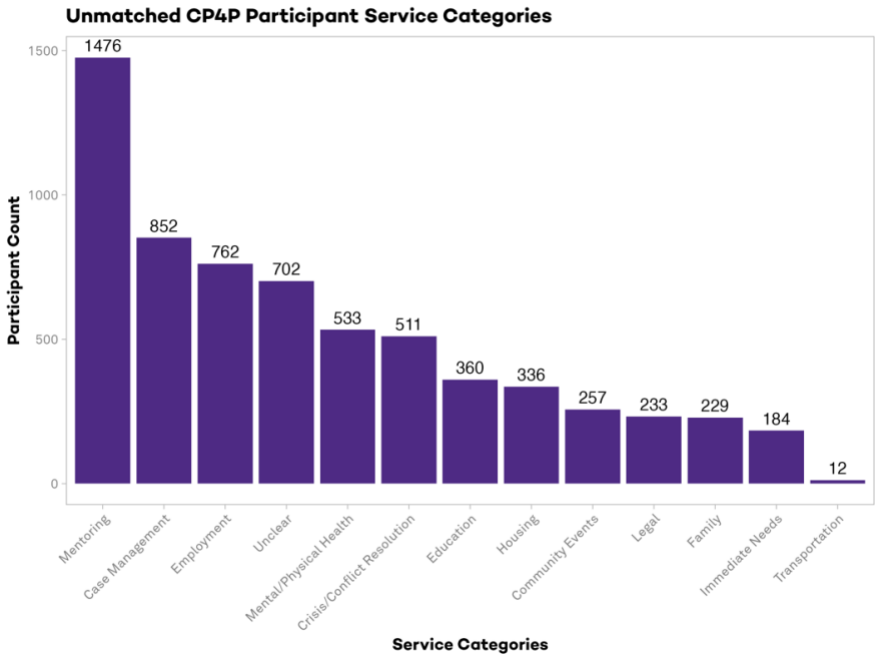

Figure S6: Number of unmatched participants receiving at least one contact in each category (n = 1647). Participants that could not be matched to CPD administrative records largely received mentoring-, case management-, and employment-focused services from CP4P providers. These participants had 71,561 total contacts with service providers, receiving 147,310 services.

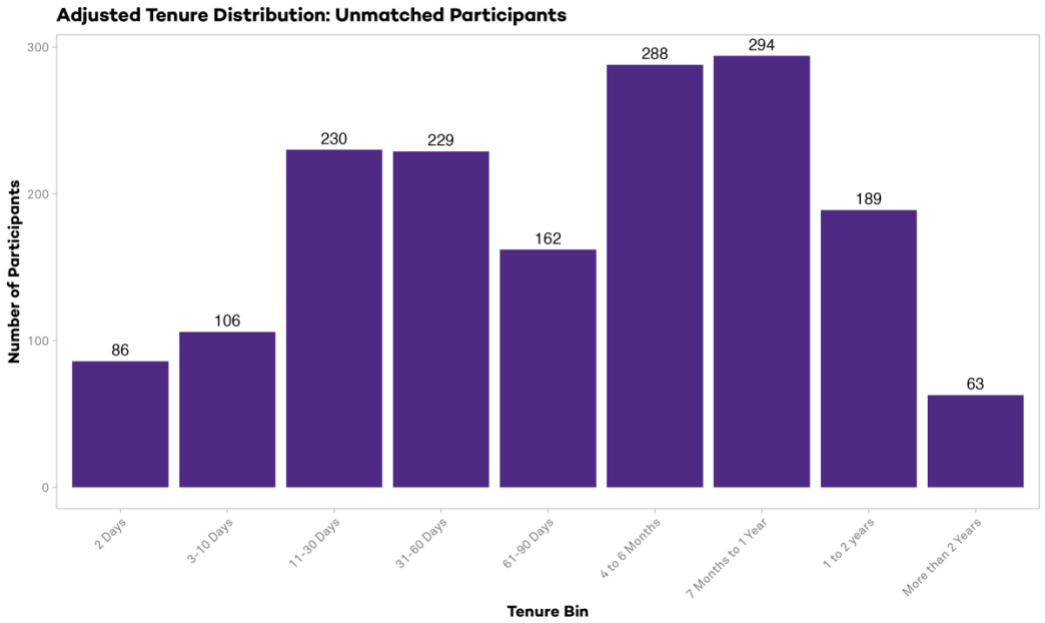

Figure S7: Adjusted tenure distribution for unmatched CP4P participants. Participants that could not be matched to CPD administrative records averaged 182 days (median 91) of active contact with CP4P provider organizations.

Table S3: Pairwise correlations of potential LCA indicator variables. Chi-squared tests for independence were conducted on all combinations of service categories; the table gives the pairs for p-value > 0.05. For model parsimony, Mentoring and Case Management were removed from the analysis, and Transportation, Immediate Needs, and Housing were combined into a "Material Needs" category, which reduced the number of correlated indicators to just two. Sensitivity analyses that iteratively removed those variables one by one showed that excluding any of those service categories only marginally improved the model fit but led to less interpretable classes.

Service Category 1	**Service Category 2**	**p-value**
Employment	Mentoring	0.76362351
Case Management	Community Events	0.74720308
Legal	Transportation	0.59452192
Community Events	Transportation	0.59373132
Case Management	Mentoring	0.52626593
Family	Transportation	0.37773148
Mentoring	Transportation	0.36563129
Employment	Transportation	0.19743058
Community Events	Housing	0.12984428
Employment	Mental/Physical Health	0.05437792

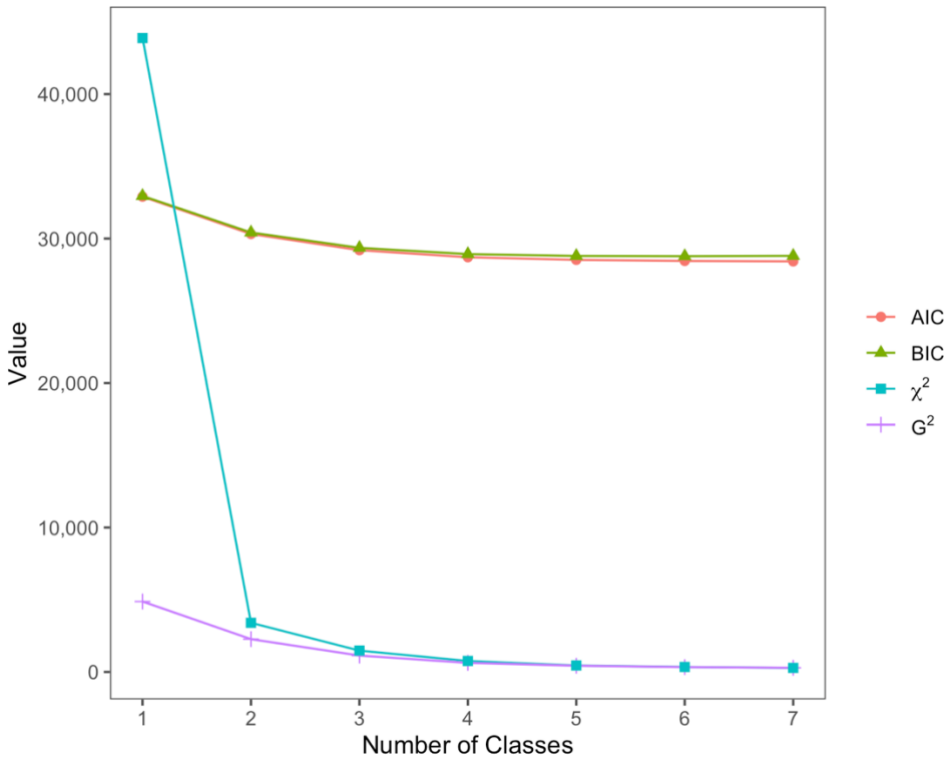

Figure S8: Scree plot of LCA evaluation metrics. The metrics include Akaike Information Criterion (labeled "AIC"), the Bayesian Information Criterion (labeled "BIC"), Chi-squared goodness of fit (labeled "χ^2"), and the likelihood ratio/deviance statistic (labeled "G^2") for 2 to 7 classes.

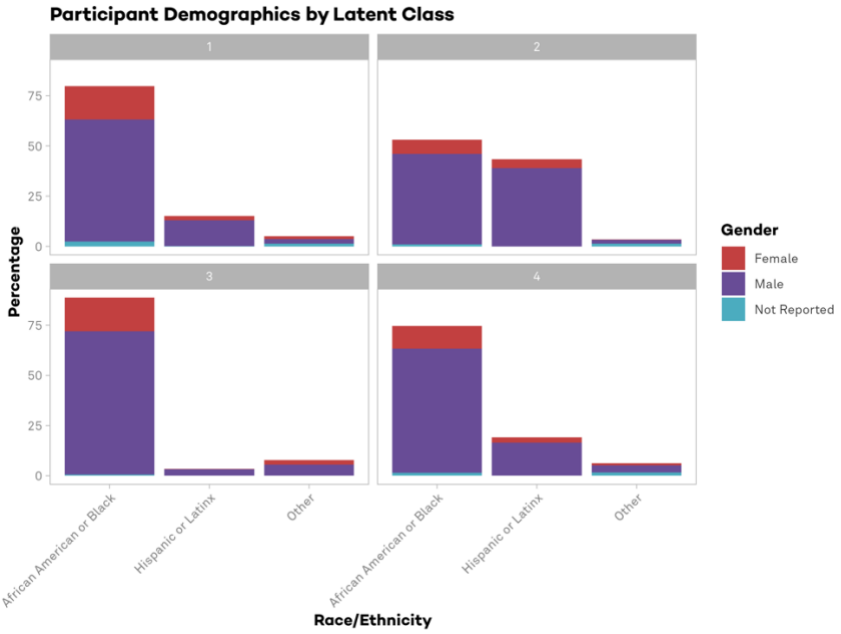

Figure S9: Participant demographics by latent class. The majority of participants in all latent classes identify as Black or African American men. In Class 2, ("High Dosage Class") Hispanic / Latino individuals comprise the largest percentage of total participants, at 43.1%.

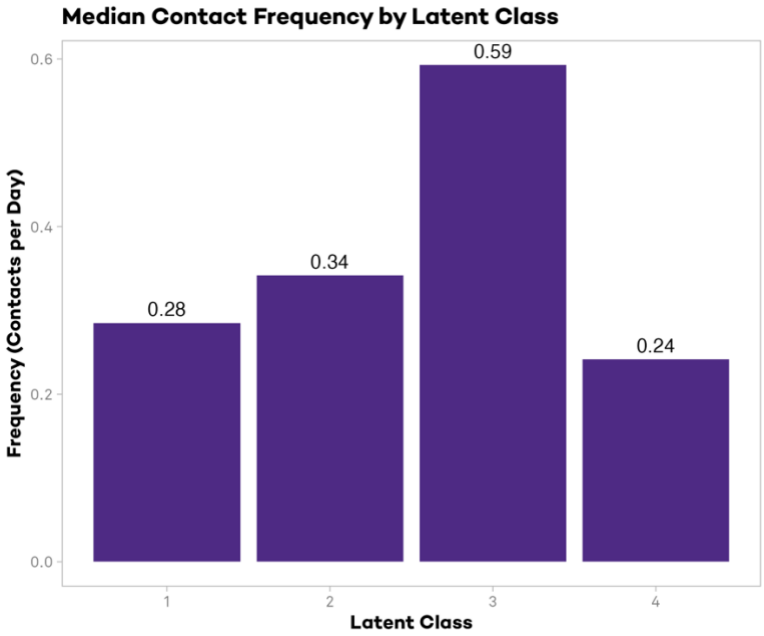

Figure S10: Median contact frequency by latent class. Individuals in Class 3 ("Behavioral Participants") have the highest daily frequency of contact with CP4P organizations, though participants in Class 2 ("High Dosage" participants) have the longest median tenure at 360 days.