

RICHMOND, VIRGINIA TECHNICAL REPORT

DEVELOPED FOR THE VIRGINIA DEPARTMENT OF
SOCIAL SERVICES DIVISION OF FAMILY SERVICES

MARCH 2019



P R E D I C T
A L I G N
P R E V E N T

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EXECUTIVE SUMMARY

Knowing that there is limited and/or unreliable funding for child maltreatment prevention and related social services, Predict-Align-Prevent (PAP) aims to leverage existing funding, local expertise, and community-wide participation in prevention activities with accountability to objective measures of population health and safety. PAP implements a novel continuous quality improvement cycle with jurisdictions committed to the prevention of child abuse and neglect. PAP is at work on a national scale seeking the combination(s) of programs, services, and infrastructure that reliably prevents child maltreatment and related fatalities across jurisdictions.

Predict: Geospatial machine learning predictions identify the places where children are at greatest risk of maltreatment, ranking the most important risk features by correlation to child maltreatment events.

Align: Information regarding community voice, the spatial allocation of prevention resources, protective assets, prevention coalitions, and population psychographics are gathered in collaboration with community partners for the purpose of developing and executing a data-driven strategic plan for prevention.

Prevent: Over time, the effectiveness of aligned prevention efforts are evaluated using objective, population-level measures of child health and safety. This quality improvement cycle is intended to uncover, strengthen, and replicate effective prevention initiatives.

PREDICT

This work was done as a collaboration between [Predict Align Prevent](#) and [Urban Spatial](#).

In conjunction with the Virginia Department of Social Services (VDSS), PAP developed a new, open-source geospatial machine learning approach to model risk of child maltreatment in the City of Richmond. For this place-based predictive risk modeling, our unit of analysis was 1000 by 1000 square foot grid cells. In the image below, predicted risk is categorized into highest risk (5) to lowest risk (1) quintiles.

Between 2013 and 2017, there were 6,500 accepted child maltreatment events in Richmond. More than two-thirds of these cases occurred in the predicted highest risk areas.

Predicted Risk Categories



Risk Category:

5 - 70.52% of child maltreatment events occurred inside the highest risk category

4 - 24.14%

3 - 4.27%

2 - 0.92%

1 - 0.16%

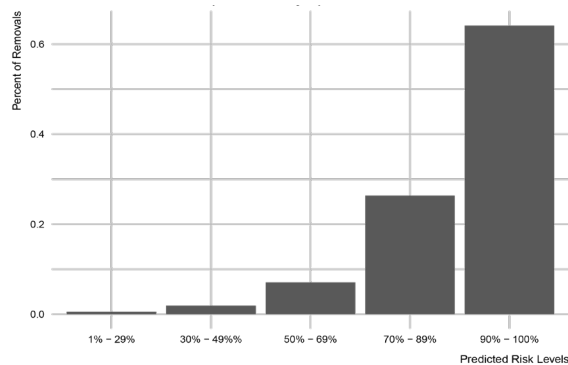
These predictions were produced by an ensemble of risk predictions generated by Poisson generalized linear, random forest, and spatial durbin submodels. Leave One Group Out Cross Validation ensured the model generalized to different neighborhoods and neighborhood contexts.

The most predictive risk factors are ranked in order of importance, so the most correlated risks can be prioritized for prevention. For clarity, only correlation is demonstrated, not causality.

For Richmond, the most important risk features were the spatial lag of child maltreatment, the number of simple domestic assaults, aggravated domestic assaults, juvenile runaways, and drug and narcotic violations. Three of the top ten were control variables describing demographic and housing unit characteristics. Additional significant factors included the nearest neighbor distance to vacant housing, pawnbrokers, and motels.

To estimate the geospatial risk predictions, features were created that describe for each area citywide, exposure to a series of risk and protective factors like distance to blight and churches, respectively. The framework supports our theory that concentrated exposure to adverse experiences increases the spatial risk of child maltreatment.

Percent of Removals by Risk Category



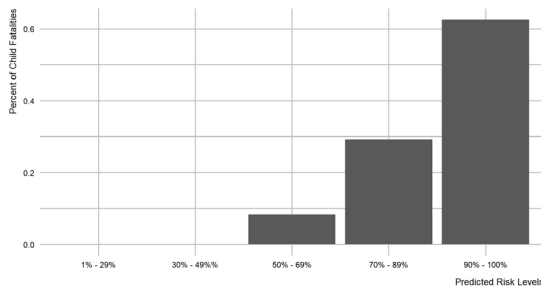
We developed several methods for validating the model. One such metric correlates predicted maltreatment risk with observed home removals. The image shows that the highest risk areas are also the places where children are removed at greater rates.

Between 2013 and 2017, there were 368 child removals in Richmond.

Removals by Risk Category

- 5 - 64.4% of removals were from the highest risk category
- 4 - 26.35%
- 3 - 7.6 %
- 2 - 1.4%
- 1 - 0.27%

Percent of Child Fatalities by Risk Category



Between 2013 and 2017, there were 34 child maltreatment deaths in the City of Richmond. This image shows that most of these deaths occur in the highest risk areas.

Child Maltreatment Deaths by Risk Category

- 5 - 62.5% of child maltreatment deaths occurred in the highest risk category
- 4 - 29.17%
- 3 - 8.3%
- 2 - 0%
- 1 - 0%

Top Concerns of Richmond Families

Percent of families surveyed	Concerns of Richmond families
93%	of families said they experience stress every day due to concerns about physical safety
90%	indicated child care is one of two most important factors in their child's development
82%	of respondents felt a sense of community isolation (not highly connected)
71%	keeping family safe
71%	of families referenced violence as a daily concern
51%	of survey respondents indicated that they have no one close by to whom they could turn for help
47%	getting where we need to be

Source: Robins Foundation Survey, October 2017

The primary concerns of Richmond families according to surveys of populations in high-risk locations are physical safety, exposure to violence, family safety, isolation, and transportation. These stated concerns provide ground-truthed validation of our findings.

ALIGN

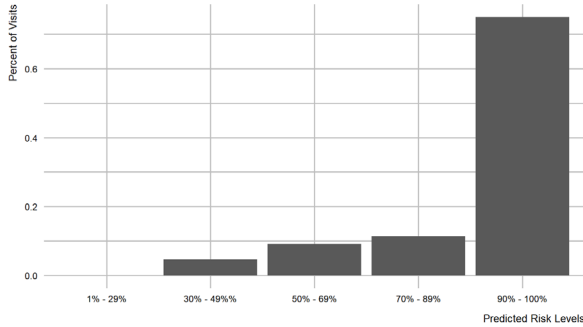
The purpose of spatial risk predictions is to find the places where prevention efforts will reach the children most vulnerable to maltreatment.

Evaluation of the spatial distribution of existing prevention resources provides strategic insight for professional, government, service, and community organizations into how resources could be more effectively allocated.

Highest risk grid cells



Percent of Visits by Risk Category



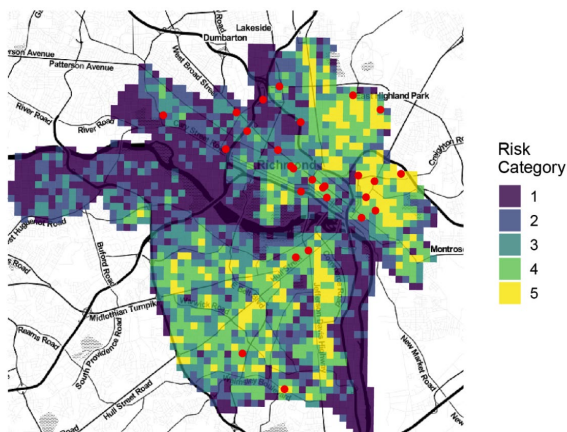
Allocation of Healthy Families Home Visitation

Healthy Families home visitation programs are effectively reaching women in the highest risk areas in Richmond.

Questions for Strategic Planning:

- How do these eligibility criteria differ from other services that are not ideally located?
- Based on population analysis of high-risk areas, what are the capacity needs for evidence-based home visitation programs?

Predicted Risk Levels and Protective Resources
 Fatalities in red



Allocation of Protective Resources

Some protective resources are located in the highest risk areas and some could be more optimally located.

Questions for Strategic Planning:

- Is there existing infrastructure in the highest risk areas where resources could be relocated?

Data Deficiencies

Death Data

Both PAP and VDSS requested the x - y coordinates for infant, child, and adult deaths which are related to risk factors for child maltreatment, and for causes of death which can be associated with the pathophysiology of toxic stress. We expect these deaths to occur predominantly in the highest risk areas, as has been demonstrated in other study locations. The geospatial distribution of death types is important because the visualization helps to bring cross-sector stakeholders together at one table to discuss common risks and common target populations across prevention topics.

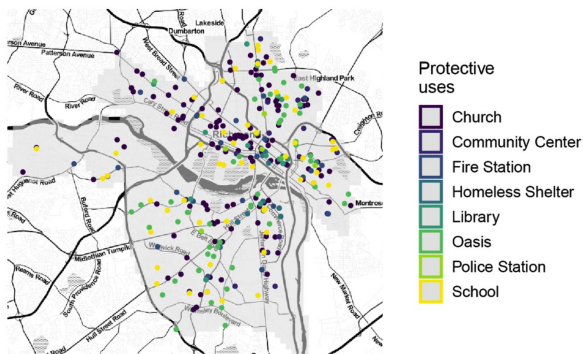
At the time this report was written, this data has not been made available to VDSS or PAP.

Prevention Program Services Data

PAP identified forty-two services offered to Richmond city at-risk children and their families through the Office of Children's Services (OCS) which administers the resources established by the Children's Services Act (CSA). We were unable to map this information as OCS, CSA and DSS were unable to provide locations for service delivery. Services data is important to analyze and visualize for the purpose of describing resource allocation, and in the long term, evaluating the effectiveness of services at a population level. Government and philanthropic funders can use this information to increase the impact of their contributions.

Protective Assets

Protective land uses



PAP finds the optimal locations for community - based prevention resources by mapping existing protective locations, such as churches, community centers, and fire stations, and then calculating the spatial child maltreatment risk near each location by drawing quarter mile buffers around each site and taking the mean count of predicted events.

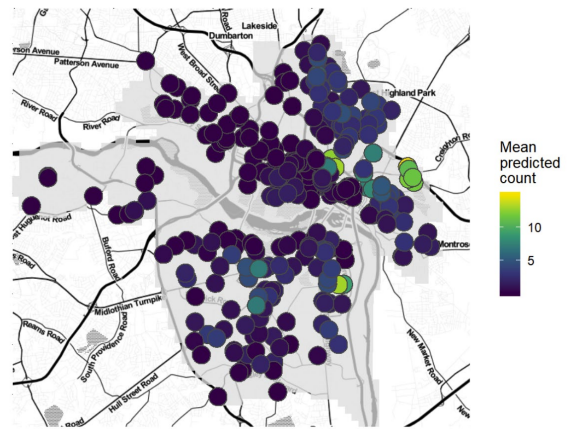
Quarter mile buffers were chosen to account for potential transportation issues for the populations accessing these resources.

Optimal Locations for Prevention Resource Allocation

Green and yellow dots are optimally located

- Shalom Baptist Fellowship Church
- Sixth Mount Zion Baptist Church
- Ebenezer Baptist Church
- Fairfield Court Community Center/RRHA
- Creighton Court Community Center
- Calhoun Community Center and Playground
- Richmond Fire Station 5
- Richmond Fire Station 16
- Ambulance Station 40
- North Avenue Branch Library
- East End Branch Library
- Hull Street Branch Library
- First Precinct
- Second Precinct
- Third Precinct
- Woodville Elementary School
- Fairfield Court Elementary School
- Preschool Development Center

Mean predicted count by quarter mile buffer
 Protective uses



Scarcity of Licensed Child Care Facilities

A protective resource which is lacking, according to the community voice, is child care. This concern is echoed by geospatial resource allocation analysis.

Mean predicted count by quarter mile buffer
 Licensed child care providers



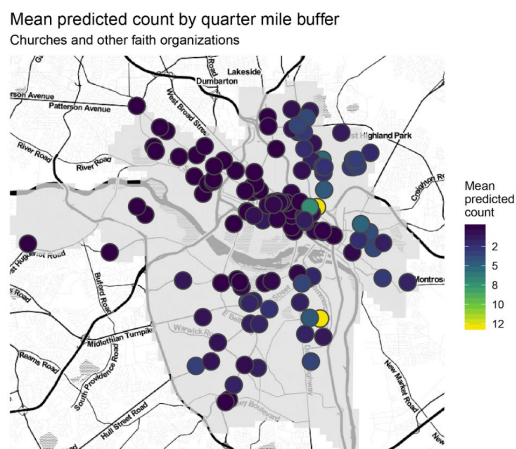
The Community Says They are Most Likely to Accept Help From:

Percent of Respondents	Source of Help
57%	of families are most likely to accept help from churches
45%	are most likely to accept help from social workers
18%	are likely to accept help from neighbors
17%	are willing to accept help from the Partnership for Families

Source: Robins Foundation Survey, October 2017

The Most Optimally Located Churches for Prevention Resource Allocation Include:

- Shalom Baptist Fellowship Church
- Sixth Mount Zion Baptist Church
- Ebenezer Baptist Church
- Swansboro Baptist Church
- New Canaan Baptist Church
- Bible Way Church
- Saint Philip’s Protestant Episcopal Church
- Bethlehem Baptist Church
- Mount Olivet Baptist Church
- Saint John Baptist Church



Existing Community Resources and Potential Champions

Research during the Align phase identified a number of organizations, coalitions, and local experts who are working to address problems with risk factors and target populations similar to child abuse and neglect. These are the community resources that are focused on child maltreatment prevention and/or prevention of problems which are risk factors for child maltreatment, as demonstrated during the Predict phase.

The list presented here is not exhaustive.

Organizations: Robins Foundation, United Way of Greater Richmond and Petersburg, Children’s Hospital of Richmond at VCU, VCU Health, Office of Juvenile Justice and Delinquency Prevention, Prevent Child Abuse Virginia, Children’s Advocacy Center, CASA, Prevent Elder Abuse Richmond, Richmond Behavioral Health Authority and Foundation, Suicide Prevention Resource Center, Hunter Holmes McGuire VA Medical Center Suicide Prevention, Children’s Mental Health Resource Center, VCU school of Education, VCU School of Social Work, Big Brothers Big Sisters, Boys & Girl’s Club of Metro Richmond, Commonwealth Catholic Charities, Capital Area Partnership Uplifting People, Change the World RVA, Child Care Aware, Children’s Home Society of Virginia, Communities in Schools, City of Richmond Department of Fire and Emergency Services, City of Richmond Police Department, Community Food Collaborative, Concerned Black Men, VA Dept. of Housing and Community Development, Diversity Richmond, Drums Not Guns, Family Life

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Line, Feed More Central Virginia Food Bank, Girls for a Change, Global Centurion, Home Again, Housing Opportunities Made Equal, Groundwork RVA, Housing Families First, Junior League of Richmond, KABOOM, Kiwanis International, Jewish Community Federation, Jubilee Family Development Center, Legal Aid Justice Center, Lions Club, Office of Community Wealth Building, Partners in Parenting, NAACP, Minority Health Consortium, Richmond City Police, Rebuilding Together Richmond, Reestablish Richmond, Richmond Academy of Medicine, Richmond Family and Fatherhood Initiative, Richmond Food Justice Alliance, Richmond City Parks and Recreation, Richmond Juvenile Detention Center, Richmond Opportunities Incorporated, Ronald McDonald House of Charities, Rotary Club, Promise Family Network, Safe Harbor, Safe Kids Virginia, The Community Builders, Inc., United Methodist Family Service, VCU Partnership for People with Disabilities, The Virginia Homeless Solutions Program, VCU Douglas Wilder School of Government and Public Affairs

Coalitions: Richmond Regional Planning District Commission, The Kids Are Not For Sale in Virginia Coalition, Virginia Takes the Lead Collaboration, Task Force on Domestic Violence in Later Life, Project EMPOWER, The Governor’s Task Force on Prescription Drug and Heroin Abuse in Virginia, The Juvenile Justice Collaborative, The Virginia Sexual & Domestic Violence Action Alliance, Maggie L. Walker Initiative for Expanding Opportunity and Fighting Poverty, Anti-Poverty Commission, Richmond Early Childhood Cabinet, Greater Richmond Trauma-Informed Community, Better Housing Coalition, RVA Food Collaborative, Virginia Community Healthcare Association

Teams: Domestic Violence Fatality Review Team, Virginia’s Maternal Mortality Review Team, Central Region Child Fatality Review Team, Children’s Hospital of Richmond at VCU Child Protection Team

Programs: The Virginia Homeless Solutions Program, Project Empower: Injury and Violence Prevention Program, Youth Violence Prevention Program, VCU Trauma Center & Injury and Violence Prevention Program, Citywide Early Childhood Development Initiative, Challenge Discovery Projects

Intelligence for Community Engagement and Prevention Messaging

The 1,000 by 1,000 square foot grid cells used for geospatial machine learning predictions were also used for an additional purpose. Working with a consumer analytics company, the dominant market segment inside each grid cell across the city was identified. In this way, we were able to learn the psychographic characteristics of the populations defined by risk category. Understanding consumer preferences, or psychographics, can be used for the improvement of community engagement and for the development of targeted prevention messaging.

It is important to note that while these are characteristics of the most dominant market segments in the specified areas, this information *does not* describe the population as a whole in the specified areas.

The Top Two Market Segments* Within the Two Highest Risk Areas are:

More Likely To

- Use public transportation
- Use ridesharing, such as Uber or Lyft
- Carpool
- Walk
- Work from home
- Work in office/administrative support roles
- Work in non-skilled hourly wage positions
- Speak English

Less Likely To

- Graduate high school
- Have a bachelor's or graduate degree
- Be engaged by broadcast/cable TV
- Retire
- Engage in church activities

Marketing Preferences Include:

- Engagement by mobile video, mobile display advertisements, online video, and online display advertisements
- Receptive to email
- Rely on Magazines to be informed (Business and Finance, Music, Teen-oriented, Men's, and Black/African American)
- Pays attention to commercials in a movie
- Interested in mainstream sports, but not as an event preference

Potential Incentives Include:

- Live dance performances
- Jazz and R&B music
- Sports memorabilia/trading cards
- E-books
- Six Flags
- Comedy clubs
- Video games and consoles
- At-home sporting events (transportation limitations for away games)
- Sea World
- Ridesharing

* Comparisons are made to averages for the general population in the USA. Segments as described by Experian's product Mosaic USA

Prioritizing Prevention Initiatives in Richmond

Violence prevention will be an important part of an effective child maltreatment prevention plan in Richmond.

In addition to directly causing safety concerns, violence in dense urban neighborhoods can be an important cause of isolation when people are effectively confined to their homes for safety. This is evident in the reported lack of a sense of community in Richmond's residents. Isolation contributes to depression, anxiety, and substance misuse which are risk factors for child maltreatment as well as being ACEs for children living in affected homes.

Violent and other crimes may also exacerbate transportation issues. The dominant psychographic profiles of households inside the highest risk geography demonstrate a likelihood to be reliant on public transportation. Unfortunately, in the highest risk areas, many bus stops demonstrate an incidence of crime that is significantly higher than other locations.

Additional infrastructure locations where the incidence of crime is significantly higher are listed in the appendices of the technical report. These locations, in addition to bus stops, act as "crime attractors" which enable ongoing criminal activity which threatens the safety of residents.

Examples of Child Abuse and Neglect Prevention Initiatives

**Predict-Align-Prevent does not endorse any particular program, service, or organization.*

Abusive Head Trauma Prevention

A community attempting to prevent abusive head injuries and related deaths in infants and toddlers can consider an array of cross-sector prevention activities. Many of these activities overlap with prevention of other types of child maltreatment, risk factors for child maltreatment, and outcomes associated with ACEs.

It is important to remember that such initiatives would ideally be implemented as part of a cohesive, cross-sector plan to address core-community risk factors such as domestic violence, community violence, isolation, crime-attracting infrastructure, lack of access to concrete supports, and unhealthy social norms.

Universal

- **Coping skills for caregivers of crying infants:** [Period of PURPLE Crying](#) provides training to all new parents to help them understand their child's development from about 2 weeks of age to 3 to 4 months, focusing particularly on safe caregiver responses to inconsolable crying.
- **New social norms discouraging interpersonal violence:** Community-wide campaigns promoting positive parenting techniques which do not include physical punishment of children, a proven precursor to physical abuse and physical abuse fatalities, is another relevant initiative. One option, the [No Hit Zone](#) program, provides resources for family homes, organizations, and communities including multiple strategies to effectively influence attitudes, norms, and behaviors around interpersonal violence.
- **Early detection of child maltreatment training for medical professionals:** Early recognition and an effective response to sentinel injuries in a health care setting can prevent severe or fatal injury. Professional training, such as the [TRAIN Collaborative](#), has quadrupled the frequency with which children are identified as having a sentinel injury in participating institutions.
- **Combating misinformation about abusive head trauma (AHT) in courts:** Court and legal professionals, medical examiners, journalists, and pediatric physicians, who may be called to testify in a criminal proceeding for a case of abusive head trauma, should be aware of the findings in professional society consensus statements, such as the [Consensus statement on abusive head trauma in infants and young children](#), which provide an evidence-base for the evaluation of AHT. This knowledge is important for prevention because misinformation, perpetuated by paid defense experts, can result in legal proceedings which allow a single male perpetrator to be involved in the abusive deaths of multiple unrelated children from different mothers over time in a single community.
- **Postpartum depression and psychosis supports and awareness:** Postpartum depression and psychosis awareness, screening, and treatment supports, such as are available from [Postpartum Support International](#)

- **ACE awareness and resilience building:** ACEs awareness programs, such as [ACE Interface](#), are designed to support rapid dissemination of ACE and resilience science, and promote understanding and application of the science to improve health and wellbeing across the lifespan.

High-Risk Areas

- **Safe child care:** Availability of high-quality child care for single working mothers that is cost appropriate, easily accessible, open for the duration of typical working hours, and has the capacity to care for infants and children with special needs. Child care is important for prevention so that mothers don't have to rely upon unrelated adults to care for their infants and children while they are at work. Optimal placement of new child care centers can be extrapolated from Predict and Align findings.
- **Awareness of perpetrator and child risk factors:** Mothers or caregivers of infants and toddlers should be aware of risk factors influencing the safety of their children while being cared for by unbonded adults.
- **New social norms discouraging community and interpersonal violence:** Violence spreads like a contagious disease, and can be prevented by reducing exposure. One option, [Cure Violence](#), is an effective community-based violence prevention program which has demonstrated significant reductions in violence in communities all over the world. *Violence prevention is critical because unsafe communities are isolated communities, and resilience is built on community connections and relationships.*
- **Readily available services for victims of domestic violence:** Family justice centers, such as [One Safe Place](#), bring together resources for victims of domestic violence, and often include child care, pet care, and emergency housing. Domestic violence is the most predictive risk feature for child maltreatment in Richmond, and is also one of the most important causes of homelessness for women and children nationally.

Mothers and Caregivers

- Evidence-based home visitation and parenting programs, such as [Nurse Family Partnership](#) and [Triple P Parenting](#)

Perpetrator Risk

- [Housing availability for formerly incarcerated people](#) with violent criminal histories that does not include responsibility to care for infants or toddlers.

PREVENTION CONCEPTS

Prevention must be a cross-sector, collaborative effort because a population's concentrated exposure to adverse experiences, including child abuse and neglect, is directly related to negative outcomes which are also risk factors for ongoing adverse experiences. Hundreds of scientific studies have established these connections. Attempts to address just one negative outcome in isolation is unlikely to be successful. Therefore, focused efforts to prevent child abuse and neglect must occur in the context of reducing a population's exposure to adverse experiences.

→ Exposure →	Adaptations →	Outcome/Risk Factor →
Adverse Childhood Experiences (ACEs): <i>Physical abuse</i> <i>Sexual abuse</i> <i>Emotional abuse</i> <i>Physical neglect</i> <i>Emotional neglect</i> <i>Mother treated violently</i> <i>Household substance abuse</i> <i>Household mental illness</i> <i>Parental separation or divorce</i> <i>Incarcerated household member</i>	Neurodevelopmental maladaptation Epigenetic modifications Altered stress response Disregulated immune response Increased fear response Decreased executive functioning Emotional reactivity Unhealthy coping mechanisms Isolation	Alcohol and drug abuse Depression and anxiety Psychological disorders Suicidality Teenage pregnancy Single parenthood Sexually transmitted infections Premature birth and low birth weight Infant mortality Risk of intimate partner and sexual violence Risk of aggressive and/or criminal behavior Chronic disease and disability Severe obesity Diabetes Cancer Heart Disease and Stroke Shorter life expectancy High utilization of health care Low school readiness rates Low 3rd-grade reading proficiency Low educational attainment More likely to miss work Unemployment Poverty High residential mobility
Enabling Infrastructure		
Unmet critical needs and capabilities		
Unhealthy social norms		

Concepts for Community-Level Prevention Opportunities:

Positive Deviance: Exposure to multiple ACEs generally results in the listed outcomes, though there will be some people and communities that do not. These outliers have adapted to their environment in a different way that changes their outcomes for the better. This community wisdom can be learned from and replicated in other parts of the community. Geospatial machine learning predictions with overlaid outcomes data help to identify positive deviance.

Professional Response: The response of medical, first responder, and social work professionals plays an important role in ACEs exposure. When addressing outcomes/risk factors, does the professional response increase ACEs for families? For example, in cases of domestic violence, are policies in place to prosecute the violent offender without requiring the cooperation of the victim? If animal cruelty is recognized, are child maltreatment and elder abuse also addressed? When women and girls of childbearing age are in a medical setting, and they do not plan on becoming pregnant within the next year, are long-acting reversible contraceptives made immediately available as the best-in-class pregnancy prevention option? Are police well trained in de-escalation techniques to avoid incarceration of nonviolent offenders? Are medical, dental, first responder, and child care personnel trained in recognition of sentinel injuries and reporting procedures?

Community Leader Response: Community leaders shape social norms. When speaking from a position of authority, these leaders can influence what is considered acceptable behavior. What is considered acceptable behavior can influence how much exposure a community has to ACEs. For example, does the faith community take a no-tolerance stance on domestic violence? Does the response to sexual abuse of children and teenagers in schools prioritize the child’s stated experience, which is almost always true? In the case of rampant child physical abuse, is physical punishment of children in the home or school setting encouraged?

Infrastructure: Some buildings and places support criminal behaviors. Predictive risk modeling identifies the specific areas where risk of child abuse and neglect is high, and which buildings and places have significantly more crime events in comparison to a city as a whole. Safety in these areas can be improved by enforcing code, addressing code violations, implementing Crime Prevention Through Environmental Design, replacing abandoned or unsafe buildings with community spaces, and making crime-attracting places less attractive.

Prevention messaging: With so many organizations, coalitions, teams, and programs working in the same places with the same people, there is an incredible opportunity to deploy impactful prevention messaging. Any approach to changing behaviors follows similar steps, from marketing of designer clothing brands to influencing voting behaviors. From a prevention context, are the local organizations, coalitions, teams, and programs working together to ensure consistency and lack of conflict in prevention messaging? Are common risk factors addressed collaboratively to increase the number of times target audiences see prevention messages? Are all organizations held to an evidence-based standard that does not spread misinformation that can be harmful to communities?

Reduction of administrative burden on vulnerable communities: Many coalitions, organizations, teams, and programs will interface with the same people from the same places. Most will conduct surveys and attempt to engage the same target populations. Working in silos, this approach can create an administrative burden in communities that need services and supports. Instead of conducting new surveys, new focus groups, new asset mapping exercises, new questions about what the community thinks the problems and solutions are, and new service mapping, how can organizations work together to use the information that has already been gathered to move toward tactical action? In addition to saving resources, this approach places less burden on community members and may improve community engagement.

Data sharing: The most qualified professional to obtain specific data should be the one collecting that data. The most reliable data source should be used. For example, if medical data is being collected, it should be collected by a skilled medical professional. If crime data is being collected, it should be from the police department. Self-reported and survey data can be utilized, but only if the answers can be objectively verified. Answers to questions that can’t be objectively verified, and represent major risk factors for child maltreatment, should not be used to assess risk.

Implementation science: The ideals of implementation programs can face significant challenges in breaking down existing silos. Often, collective initiatives splinter into sub-groups that mirror the previously existing committees and task forces, and with the same barriers to change. The aim of cross-sector collaboration is to simplify, standardize, and centralize wherever possible. The “backbone” organization(s) should be the one(s) that “own” the most protected data and can drive continuous quality improvement based on that data. A place to begin cross-sector collaboration is to define major risk factors for each organization’s area of focus to identify overlap.

Philanthropy: Funders set expectations and requirements for what outcomes are measured. Do funders require objective, verifiable outcomes for the ongoing allocation of resources? Are outcomes expectations linked for programs intended to address problems with similar risk factors and target populations?

Ethical Evaluation of the Predict-Align-Prevent Program

According to an independent ethical analysis of the Predict-Align-Prevent Program performed by Tim Dare of the University of Auckland, “A key issue in assessing whether social policy uses of predictive modeling tools are ethical is determining whether, on balance, the benefits they deliver outweigh the adverse consequences they threaten or deliver. On the benefit side of the equation, I accept that the benefits which might be delivered by an effective child maltreatment prevention program are enormously significant – they warrant taking some risk and even imposing some certain costs – and I accept that the PAP program has the potential to contribute toward the development of effective child maltreatment prevention programs.”

“The PAP program does, in my view, threaten some adverse consequences, including, for instance:

- the potential stigmatization of neighborhoods;
- the possibility of increased surveillance (and hence the generation of reinforcing data);
- the possibility that marginalized families will respond to the program by removing their children beyond the scope of child protection services in that community, for example, by moving to another neighborhood;
- Potential indirect discrimination against groups who seem almost certain to be overrepresented in the neighborhoods identified as high-risk; and
- Some relatively minor threats to the privacy of information gathered at the Align and Prevent phases are not managed appropriately;

Some of these risks are relatively minor. Others can, in my view, be mitigated by way of the recommendations included in this report.

Overall, for reasons discussed under the various sections above, I am satisfied that the benefits of the PAP program outweigh the costs it is likely to impose.” The full report is [available here](#).

PREVENT: NEXT STEPS FOR RICHMOND

In the PREDICT phase, we found the places where children are at greatest risk of maltreatment, ranking the most important risk features by correlation to child maltreatment events. The majority of child removals and child maltreatment fatalities occurred in the predicted highest risk locations.

During the ALIGN phase, we identified the existing community voice, potential protective assets, potential community “champions” for prevention work, coalitions and service providers working on problems with similar risk factors and target populations, specific crime-attracting infrastructure, and psychographics for optimal community engagement.

Remaining data needs for analysis include the x-y coordinates for specified death types so that cross-sector stakeholders can visualize how their ACEs-related areas of focus co-occur in the same places, and are inextricably linked to child abuse and neglect. This is a critical step for cross-sector engagement for strategic planning.

The next step is to work with cross-sector stakeholders to apply this intelligence to tactical action for the prevention of child maltreatment. The focus of strategic planning for prevention includes:

- Collaboration among coalitions working to prevent problems with similar risk factors and target populations (minimize duplicative or conflicting efforts, maximize shared resources)

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- Executive leadership and policies in support of evidence-based and evidence-informed practices
- A cross-sector customer experience design which engages and sustains community relationships
- Longitudinal population-level health and safety metrics for evaluation of the effectiveness of aligned resources
- Objectively effective prevention programs and services
- Prevention funding to meet capacity needs for effective services

A detailed technical report follows.

PREDICT

PROGRAM PHASE SUMMARY



P R E D I C T
A L I G N
P R E V E N T

PREDICT

Program Phase Summary

Background

In the United States, between 1,500 and 3,000 infants and children die due to abuse and neglect each year, and children aged 0-3 years are at the greatest risk for maltreatment and related fatality.

A distinctive characteristic of the infants and young children most vulnerable to maltreatment is their potential lack of visibility to the most common types of mandatory reporters such as teachers, medical professionals, and law enforcement *before* they sustain harm. Approximately half of infants and children who die from child maltreatment are not known to child protection agencies before their deaths.

Children who survive early-childhood abuse, neglect, and chronic adversity often suffer a lifetime of physical, mental, educational, and social health problems. Long-term outcomes include shorter life expectancy, chronic disease and disability, obesity, smoking, alcohol and drug abuse, risk of intimate partner and sexual violence, depression and anxiety, suicidality, sexually transmitted infections, unintended and/or teenage pregnancies, low birth weight and fetal death, psychological disorders, risk of aggressive and/or criminal behavior, low educational attainment, unemployment, and poverty.

The spatial relationship of maltreatment with Adverse Childhood Experience (ACEs) - related outcomes provide the foundation for geospatial risk modeling which can be used to predict the locations of future child maltreatment events. Our research indicates that child maltreatment and related fatalities tend to cluster in places where exposure to adverse experiences accumulates. This type of geospatial analysis is crucial for the evidence-based prioritization of risk-mitigating and prevention methods so that child abuse and neglect interventions can be employed more efficiently and effectively.

Predict Align Prevent's (PAP) approach to identifying effective preventative solutions begins with its use of location-based predictive analytics. The more common approach is person-based predictive analytics. Person-based predictive analytics can be beneficial in their ability to guide interventions to specific people, potentially preempting a maltreatment event, but person-specific predictive resolution comes at a cost. They require person-level data, often necessitating a jurisdiction to overcome the significant legal, bureaucratic, and financial costs that are required to integrate or link private, cross-agency administrative data. On the other hand, the place-based predictive analytics utilized by PAP require only the location at which a certain type of event has occurred in the past and so represents a significant reduction in administrative burden, cost, and privacy concerns. This report incorporates an independent ethical analysis of a use case for place-based predictive analytics.

PREDICT phase activities include:

- Submission of research protocol for IRB approval
- Identification of data sharing agreement needs and options
- Geospatial risk modeling
- Baseline community health and safety metrics
- Establish best practices for mapping, aiming at higher precision/quality/standards for maps tied to minimum viable qualities for success in later steps

- Create and deliver technical report that includes initial predictive analytics, service matching, capacity needs and gaps analysis, psychographics, and recommendations for prevention programs/activities

PREDICT, a Collaboration Between VDSS and PAP

Study area description

The City of Richmond, Virginia, is the capital of the Commonwealth of Virginia and has an area of 62.5 square miles. According to the United States Census Bureau, in 2017, the population estimate was 227,032, an increase of 11.1% from 2010. Of the approximately 41,000 children, 13,850 were under 5 years old. 48.2% of the population identified as African American, 44.7% as White, 6.5% as Hispanic or Latino, 3.5% as two or more races, and 2.1% as Asian. 76.3% of persons aged 1 year+ were living in the same house as 1 year ago. 84.5% of persons aged 25 years+ were high school graduates or higher between 2013-2017, and 25.2% lived in poverty.

Richmond was selected by VDSS as a pilot site for the PAP program. Between July 2013 and July 2017, there were 6,500 accepted cases of child maltreatment allegations in Richmond. Accepted allegations are reports determined to be valid according to the CPS Intake Tool, which can be retrieved from The VDSS Child and Family Services Manual Appendix D, pages 48-50.

http://www.dss.virginia.gov/files/division/dfs/cps/intro_page/manuals/10-2016/section_3_complaints_and_reports.pdf

Table 1

Year	Location	Accepted Allegations*
7/1/2016 to 6/30/2017	Richmond City	1,434
7/1/2015 to 6/30/2016	Richmond City	1,570
7/1/2014 to 6/30/2015	Richmond City	1,476
7/1/2013 to 6/30/2014	Richmond City	2,051

*Virginia OASIS data retrieved from https://www.dss.virginia.gov/geninfo/reports/children/cps/all_other.cgi

IRB Approval/Waiver Letter



VIRGINIA DEPARTMENT OF
SOCIAL SERVICES

February 2, 2018

TO: Carl Ayers, MSW
Division of Family Services
Virginia Department of Social Services 801 East Main Street
Richmond, Virginia 23219

Dyann Daley, MD
Predict-Align-Prevent, Inc. 1205 Kirkcaldy Street
Southlake, Texas 76092

FROM: Gail C. Jennings, PhD
Chairperson, VDSS IRB (Acting)

RE: VDSS IRB # 2018-09

Title: An Exploratory Geoanalysis of Child Maltreatment, Related Fatality, and the Pathophysiology Associated with Chronic Exposure to Adverse Events in the Commonwealth of Virginia

Funding Source(s): None.

Study Summary: The proposed study will retrospectively investigate the rate and nature of child maltreatment occurrence and distribution in select localities within the Commonwealth of Virginia. VDSS research staff will use data from state fiscal years 2014-2017 for Richmond City. In order to track outcomes longitudinally and to evaluate the effectiveness of prevention strategies that are implemented locally, VDSS will conduct follow-up analysis, that is, periodically (every six months) re-run the spatial analysis using additional data collected for state fiscal years 2018 through 2021. Richmond City will be the analysis area for a pilot project. If successfully implemented, the same approach will be replicated in other localities throughout the state. Using geospatial analytical techniques (e.g., kernel density mapping, risk terrain modeling), research staff at VDSS will explore the geospatial patterns of associated risk and protective factors, if such are found to exist. Investigators will generate a series of hotspot, coldspot, and risk terrain maps that will be applied to community and neighborhood centered alignment and prevention efforts. Risk factors include, but are not limited to, geographic locations of crimes, socioeconomic indicators, commercial properties and zoning, and environmental characteristics. This study will also include a cross-sectional analysis of community-based assets to determine if such assets assert a protective influence on children and families and to locate those geographic areas within the state

that are lacking in services and protective factors that may be influential in preventing child maltreatment. The proposed retrospective and cross-sectional analyses will utilize data collected by secondary sources (child welfare administrative data, vital records, crime records) and will not require additional contact with or active participation by identified subjects. (The PI is requesting a waiver for obtaining informed consent from clients.) Information that may enable re-identification of study subjects will not be shared outside of VDSS. Street addresses of crime events are based on public arrest and adjudication records and will be collected from local law enforcement, court, and corrections agencies using their respective public information request systems. Additional data collection from community-based nonprofits, resource centers, state, and social services may also be necessary to create a comprehensive and robust dataset of community assets. Upon receipt of external data, data cleaning will be performed to create multiple datasets organized according to the analysis requirements. The location data will be geocoded into X-Y coordinates in combination with kernel density estimation as implemented in ESRI's ArcGIS Spatial Analysis (Quartic bivariate kernel), or substantially similar cluster analysis.

The proposed study seeks to: 1) identify high-risk places based on environmental features; 2) strategically work with communities and providers to align services, education, and resources where they are most likely to reach children at risk; and 3) establish baseline data and actively conduct surveillance of risk, protective, and outcomes metrics in high-risk places to measure the efficacy of specific implementations of prevention programs in identified high-risk places, and to inform ongoing prevention efforts.

VDSS/LDSS Role: The VDSS Office of Research and Planning GIS analysts will extract, clean, and prepare the child welfare administrative data for geospatial analysis as described above.

VDSS staff are required to abide by state and agency privacy rules when handling client data (all VDSS staff sign non-disclosure agreements upon start of employment and renew these agreements yearly.) VDSS will establish data sharing agreements with local governments and state government agencies to obtain secondary address-level data. VDSS will consult with Dyann Daley (and other staff) from Predict-Align-Prevent in regards to the analysis and application of results. The VDSS IRB will provide the necessary human subjects research training to study staff and partners.

IRB Approval: Because this study involves no more than minimal risk and the research activities fell within the accepted categories, an expedited review was completed by two members of the VDSS Institutional Review Board on January 29, 2018. On January 31, 2018, the PIs responded to several follow-up questions posed by the two IRB members. As stated in the attached email response (and which I summarize here), the PI confirmed or agreed to the following conditions:

- The PIs confirmed that this project does not receive any external funding.
- The PIs clarified that the study will involve analysis of secondary data collected through end of June 2021 (as described above under “Study Summary”). Allowing time for the analysis to be completed, the IRB approves the project through January 31, 2022.
- The PIs confirmed that Richmond City data will be used in a pilot phase starting in 2018. VDSS will perform subsequent analyses using data for other localities in Virginia. If the pilot venue changes, the PI is required to immediately inform the VDSS IRB in writing. If VDSS extends the analysis to include other localities, the PI is required to inform the VDSS IRB.
- The PIs must inform the VDSS IRB of any other modifications to the study, including changes to the protocol (e.g., addition of new data elements, change in analytic techniques, change in Key Study Personnel). (Submit the “Modification to Approved Study”, which is located on the IRB web page.) Modifications must be reviewed and approved by the VDSS IRB prior to implementation. No new data can be received and analyzed unless approved by the IRB.

- The PIs agreed to include the following statement -- “VDSS staff are subject to all VDSS privacy rules and regulations” – in their protocol and also will abide by the terms and conditions that they described in their protocol for handling the study data.
- The PIs must send copies of signed data sharing agreements established between VDSS and other state and local agencies for the purposes of this study.

This study is approved for a period of four years. **Approval is effective February 2, 2018 and expires on January 31, 2022.** You are required to submit an annual project status report by January 31st of each year -- use the “**Continuing Review Form**” on the VDSS IRB web page.

(<http://www.dss.virginia.gov/about/irb.cgi>)

Furthermore, the VDSS IRB approves the waiver of obtaining informed consent from VDSS clients for using their data in this study. The study, which involves analysis of existing administrative data, poses no more than minimal risk. GIS analysis masks the exact address of clients with accepted procedures, and measures are being taken to protect the confidentiality of all client’s data.

At the conclusion of the study, you are required to submit the “**Study Close-Out Report**”. As required by Virginia legislative mandate (§32.1-162.19), results of completed studies must be summarized in the IRB annual report and made available to the public on the IRB Internet web site. Please provide an abstract documenting the findings from the study as soon as practicable.

This approval includes the following items reviewed:

1. Request for Initial Review (dated 1/3/2018)
2. Request of Waiver for Informed Consent (dated 1/3/2018)
3. Description of Protocol (“VDSS.PAP Protocol Resubmission (dated 1/1/2018), which includes Appendices A and B which list the data elements that will be used in the analysis (data listed in Appendix A will includes either addresses or X-Y coordinate information)
4. Cook Children’s Health System IRB-Approval Protocol for Texas Study and IRB approval letter (received on 1/29/2018)
5. Biography for Carl Ayers and Curriculum Vitae for Dyann Daley
6. Documented CITI training for Dyann Daley, Shawn Dolley, Carl Ayers and Elizabeth Overall
7. Email response from Elizabeth Overall and Dyann Daley to questions and requests from the VDSS IRB (dated 1/29/2018 and 1/30/2018)

Conditions of Approval Research Conducted or Authorized by the Virginia Department of Social Services, Any Agency or Facility Licensed by the Department, Local Departments of Social Services, or any VDSS contractor:

In order to comply with federal and state regulations, and the terms of this approval, the investigator must:

1. Conduct the research as described in and required by the Protocol.
2. Obtain prior approval from the VDSS IRB before implementing any changes.
3. Monitor all problems (anticipated and unanticipated) associated with risk to research participants or others. Report Unanticipated Problems (UPs), including protocol deviations.
4. Promptly report and/or respond to all inquiries by the VDSS IRB concerning the conduct of the approved research when so requested.

5. Promptly report and/or respond to all inquiries by the VDSS contract administrator concerning the conduct of the approved research when so requested.
6. The VDSS IRB operates under the regulatory authorities as described within:
 - a. U.S. Department of Health and Human Services Title 45 CFR 46, Subparts A, B, C, and D (for all research, regardless of source of funding) and related guidance documents.
 - b. Commonwealth of Virginia Code of Virginia 32.1, Chapter 5.1 Human Research (all research).
 - c. Commonwealth of Virginia Administrative Code Title 22. Social Services, 22VAC40-890 et seq (all research).

Requested variables for this study included:

Dependent Variable

Child Maltreatment Events
Date (month/year)
Age (in months if under 1 year, in years between age 1-17)
Time of confirmed incident (if known)
Type(s) of maltreatment
If the child was placed in state care
If the case represents recurrence
Reporter type

Independent Variable Category: Potential Community Protective Resources

Infrastructure

X-Y coordinates

Faith communities
Pharmacies
Licensed child care
Community centers
Crisis shelters
Homeless shelters
Food pantries
Grocery stores
Schools
Police stations
Fire stations
Medical clinics
Dental clinics
Women's Health clinics
Parks
Playgrounds
Safe Haven Law sites

Programs and Services

Date, time, and X-Y coordinates

Prevention and early intervention service recipient residence location by type of service billed

(indicating utilization of services)
Prevention and early intervention service delivery location(s) by type of service (to determine accessibility to highest-risk population)
Foster child service delivery locations by type
Foster homes by category (or foster placements)
Available foster homes

Independent Variable Category: Risk Factors

Crime (Antisocial behavior of community adults)

Police report number, date, time, and X-Y coordinates

- Aggravated assaults
- Domestic violence (all types of crimes flagged or reported as domestic/family violence)
- Runaways (resident locations of runaways, not harboring of runaways)
- Prostitution-related charge
- Sex trafficking
- Gang-involved & gang-related violence (all crimes that involved at least one gang member and were flagged or reported as gang related/involved)
- All robberies, including residential/commercial and aggravated
- Drug & narcotic-related violations
- Murder (all degrees, including manslaughter)
- Animal cruelty/abuse incidents
- Animal aggression incidents
- Elder abuse

Infrastructure (Potential crime attracting locations)

X-Y coordinates

- Bars
- Car repairs
- Car washes
- Convenience stores
- Gas stations
- Laundromats
- Liquor stores
- (Payday) loans
- Nail / Hair salons
- Pawn shops
- Motels
- Bus stops

Code violations (Potential indicators of economic deprivation and/or community Disorganization)

Date, time, and X-Y coordinates

- Animal
- Health Hazard
- Property Maintenance
- Waste Violation
- Substandard Building
- Vehicle
- Zoning

Independent variables: Population health metrics

Deaths

Age at time of death

Date of death

Cause(s) of death

Manner of death

Residence location

Place of death location

If death is injury-related, location where injury occurred

Injury-related death, Infant and child

- Homicide
- Fire-related
- Unrestrained motor vehicle
- Drowning
- SUID
- Strangulation
- Asphyxiation
- Weapon-related
- Penetrating injury
- Auto-pedestrian
- Auto-bicycle
- Bicycle
- Heat stroke / hyperthermia
- Poisoning
- Overdose
- Falls
- Animal bites / mauling
- Suicide

Injury-related death, adult

- Homicide
- Suicide
- Gang violence
- Weapon violence
- Strangulation
- Overdose
- Traumatic brain injury
- Motor vehicle accident

Other death types

- Infant mortality, any cause
- Maternal mortality, any cause
- Asthma
- Early death, any cause (<65 years old)

Data Sources

The data sources we were able to access are listed below.

Table 2

Dataset	Source
Bus Stops	City of Richmond, Department of Economic and Community Development
Community Centers	City of Richmond
Fire Stations	City of Richmond
Homeless Shelters	City of Richmond
Libraries	City of Richmond
Parks	City of Richmond
CPS Accepted Cases	Virginia Department of Social Services, Child Welfare Case Management System (OASIS)
Points of Interest	City of Richmond
Police Stations	City of Richmond
Public Schools	City of Richmond
Resource Homes	Virginia Department of Social Services, Child Welfare Case Management System (OASIS)
SNAP Locations	Virginia Department of Social Services, Eligibility System (VACMS)
Voting Stations	City of Richmond
City Health and Safety Code Violations	City of Richmond, Department of Human Services
Healthy Families Home Visits	Virginia Department of Social Services, Healthy Families program
Home Removals	Virginia Department of Social Services, Child Welfare Case Management System (OASIS)
SCAN Prevention Resources	Greater Richmond Stop Child Abuse Now nonprofit

Variables Summary Description

Table 3 - Conceptualization of Crime Indicators as Spatial Risk Factors for Child Maltreatment

Indicator and Definition	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention Opportunities
<p><u>Domestic Violence (DV)</u> <i>Domestic violence (DV)</i> is defined as a pattern of abusive behavior in any relationship that is used by one partner to gain or maintain power and control over another intimate partner.¹</p>	<ul style="list-style-type: none"> ● Children witness domestic violence between their parents, a parent and their significant other, and/or between older children in the household.¹ ● There is a direct correlation between the co-occurrence of DV and child physical abuse.²⁻⁴ 	<ul style="list-style-type: none"> ● Low education status⁵ ● Poverty, low economic status and employment rate^{5,6} ● High alcohol and substance abuse rate⁵ ● High crime and public disorder⁶ 	<ul style="list-style-type: none"> ● Strengthen DV protocols^{7,8} ● Empathy and self-control intervention therapies at school^{7,8} ● Community programs that reinforce woman equality^{7,8} ● Open discussion and destigmatizing DV^{7,8}
<p><u>Animal Abuse, Aggression, and Bites</u> <i>Animal abuse</i> is the infliction of physical pain, suffering, or death on an animal.⁹ <i>Animal aggression</i> is an animal's display of aggressive tendencies such as growling, barking, snapping, or biting.^{10, 11}</p>	<ul style="list-style-type: none"> ● Animal abuse, aggression, and bites are indicators of child maltreatment and domestic violence.¹² ● Animal abuse by an adult and/or the child, themselves, are both indicators of child maltreatment.¹³⁻¹⁷ ● Children at the age of 9 or younger are at higher risk for animal aggression and/or bites.^{18, 19} 	<ul style="list-style-type: none"> ● There is a strong co-occurrence between animal abuse and family/domestic violence.^{14, 16, 20} ● Animal cruelty correlates with illegal firearms possession, drug trafficking, gambling, and spousal and child abuse, rape and homicide.^{17, 18, 21, 22} 	<ul style="list-style-type: none"> ● Dissemination of information and legislation that make animal abuse a human welfare issue that is an indicator of child maltreatment and domestic violence.^{12, 15, 16, 20, 23}
<p><u>Runaways</u> <i>Runaways</i> are youth that lack adequate shelter and other provisions, putting them at risk to engage in harmful behaviors.²⁴</p>	<ul style="list-style-type: none"> ● The child is a runaway or affected by the negative impacts associated with runaways in the community.²⁵ ● Children between the ages of 11–18, that identify as LGBTQ, and/or are part of a dysfunctional household are at a higher risk of becoming a runaway.^{26, 27} ● Runaways are at higher risk to be victims of child maltreatment.²⁸ 	<ul style="list-style-type: none"> ● Approximately 60% of runaways remain close to their home.²⁷ ● Communities with higher rates of prostitution, poverty, and drug sales.²⁸ 	<ul style="list-style-type: none"> ● Community protective factors with an emphasis on providing housing and job training.^{24, 26, 27} ● Self-esteem and self-efficacy training programs.^{24, 26, 27}
<p><u>Prostitution</u> <i>Prostitution</i> is defined as providing sexual services in exchange for money or other materials goods.^{29, 30}</p>	<ul style="list-style-type: none"> ● The children of prostitutes are at greater risk of maltreatment.²⁹⁻³⁴ ● The child is affected by the social disorganization with the community associated with prostitution.^{31, 35} 	<ul style="list-style-type: none"> ● Homelessness and other forms of social exclusion³⁴ ● Mental health problems³⁴ ● Violence³⁴ ● Runaways³⁴ ● High immigrant population³⁴ ● Areas with high drug and alcohol abuse³⁴ 	<ul style="list-style-type: none"> ● Community drug and alcohol treatment facilities specifically for prostitutes.^{31, 32, 34-36} ● Collaboration between communities and social service systems that improve economic stability and provide a support system (e.g., child care).^{31, 32, 34-36}

Child Injury Indicators as Risk Factors for Child Maltreatment - Desired Data

The following 15 indicators were sought for Richmond but were not available at the time of this report.

Table 4 - Animal Bites Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention Opportunities
<p>Animal Bites Animal bites include dog bites, insect stings and other animal bites.¹⁻⁵</p> <p>Animal bites comprise 6% of non-fatal injuries among children 0-19 years of age.¹⁻⁵</p> <p>Dog bites are the second most frequent cause of visits to emergency rooms from activities common among children.¹⁻⁵</p> <p>Animal bites can be provoked or unprovoked.¹⁻⁵</p> <p>4.5 million dog bites occur each year.¹⁻⁵</p> <p>78% of dog bites occur in the home.¹⁻⁵</p> <p>An estimate of approximately half of children 12 years old and younger have been bitten by a dog.¹⁻⁵</p> <p>Children 0-9 years old are most at risk, with highest risk for children around 2 years old.¹⁻⁵</p>	<p>The occurrence of animal bites indicate a lack of parental supervision.¹⁻⁵</p> <p>Dog aggression correlates with domestic violence and both correlate with a higher probability of child maltreatment.^{3, 6-8}</p> <p>Parents with ACEs are more likely to abuse and mistreat an animal.⁹</p> <p>Homes and communities where domestic violence, violence, and aggravated assault take place put a child in danger of aggressive dogs and dog bites.^{3, 6-8}</p> <p>Dog bite injuries can be temporary or lasting and include pain, disfigurement, infection, time lost from school, fear, anxiety, and/or post-traumatic stress disorder.^{1, 3, 10, 11}</p> <p>While children are at risk for rabies and other diseases, they are also at risk for wound infection depending on the type of bite and where it takes place due to lack of proper follow-up medical care.^{3, 6-8, 12}</p>	<p>Spatial areas of high risk include ones where parental ACEs are high, and there is a lack of health literacy and access to veterinarians.^{1, 5, 11, 13}</p> <p>Areas that lack low-cost veterinary services, since a dog is more likely to bite if in pain and/or has an untreated disease.^{3, 6-8}</p> <p>Areas with high poverty are associated with lack of health literacy and how to treat different types of animal bites.⁹</p> <p>Communities with chained dogs, since a chained dog is 3 times more likely to bite due to lack of proper socialization.^{3, 6-8}</p> <p>Communities with higher numbers of German shepherds and/or Dobermans. A dog attack by a German shepherd or a Doberman is approximately 5 times higher than that of a Labrador retriever or cross-breed.^{1, 3, 10, 11}</p> <p>A child's size correlates with likelihood of a dog bite. If the child is the same size or smaller than the dog, the animal is more likely to bite.^{1, 3, 10, 11}</p> <p>Children that are at an age during which they cannot distinguish between playful or harmful behavior are more likely to be bitten.^{1, 3, 10, 11}</p> <p>Children that have high impulsivity, low inhibitory control, low shyness, and high approach are more likely to approach a dog more quickly and to take more risks when interacting with a dog.^{1, 3, 10, 11}</p>	<p>Proper follow-up investigations after dog bites to rule out domestic violence and/or child maltreatment concerns.^{1, 5, 11, 13}</p> <p>The best prevention is training both dogs and their owners. Community parent classes geared toward dog training and appropriate environment and teach child behavior toward animals. The following concepts have been identified as important teachings for parents: never leave a young child alone with an animal; teach your child not to tease or hurt an animal; teach your child to avoid strange dogs, cats, and other animals; have your pets licensed and immunized against rabies and other diseases. Parents should also be trained on the proper way to handle bites, specifically reaching out and understanding how to treat a small wound as to not get infected and recognize flu-like symptoms as sign of infection.^{1, 5, 11, 13}</p> <p>Availability of low-cost vets within the community and/or mobile vet units with rabies vaccines.^{1, 5, 11, 13}</p> <p>Free and/or low-cost health care to prevent post infection after animal bites.^{1, 5, 11, 13}</p>

Table 5 - Asphyxiation Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention Opportunities
<p>Asphyxiation <i>Asphyxiation</i> is defined as the lack of oxygen or excess of carbon dioxide in the body that results in death or cognitive damage due to the result of the interruption of breathing. There are several types of asphyxiation.¹⁻⁵</p> <ul style="list-style-type: none"> ● <i>Choking</i> is defined as the interruption of respiration by an internal obstruction of the airway, usually by a food item or small object.¹⁻⁵ ● <i>Suffocation</i> is defined as the obstruction of the airway by an external object that blocks the nose and mouth, such as a plastic bag, bedding, or mattress.¹⁻⁵ ● <i>Strangulation</i> is defined as the external constriction of the neck that interferes with respiration and may be caused by a curtain cord or clothing drawstring.¹⁻⁵ <p>In 2009, 1,099 children under the age of 15 died due to unintentional choking and/or strangulation. 94% of these deaths were in children under the age of five.¹⁻⁵</p> <p>60% of non-fatal ER choking incidents are food related.^{3,6}</p> <p>Asphyxiation is strongly correlated with SUID (Sudden Unexpected Infant Death).¹⁻⁵</p>	<p>Asphyxiation can result in mild to severe brain damage due to the deprivation of oxygen that leads to multiple medical conditions, attention deficit disorders, hyperactivity, and neurodegenerative disease. Experiencing asphyxiation and dealing with its consequences can result in ACEs.^{7,8}</p> <p>Siblings of children that have died due to asphyxiation and/or deal with the consequences of asphyxiation can indirectly experience ACEs.^{7,8}</p> <p>Instances of child asphyxiation can indicate lack of supervision and neglect.⁹</p> <p>Parental ACEs heighten alcohol and drug abuse, which can lead to unsupervised situations^{9,10} and low health literacy.¹¹</p>	<p>Poverty and low socioeconomic status are highly correlated determinants with asphyxiation.⁹</p> <p>The majority of asphyxiations occur in the home.¹²</p> <p>Children younger than 5 years old such as toddlers and preschoolers, as well as children with special needs, are most at risk for asphyxiation.^{3,6}</p> <p>Children between the ages of 0–3 years old are most at risk for food-related choking since their airways are still developing.^{3,6}</p> <p>Children with older siblings since there will be more toys that are not age appropriate and so pose a choking hazard.^{3,6}</p> <p>Children with developmental delays are at a higher risk for asphyxiation.⁵</p> <p>There is a correlation between race and incidents of asphyxiation. Races impacted by asphyxiation from highest to lowest: American Indian/Alaska Native, Non-Hispanic black, Non-Hispanic white, Hispanic, Asian.⁵</p>	<p>Interventions and resources through different agencies need to take place that continuously educate on safe toys and safe environments, age-appropriate food items, and supervision. The programming must be health literate for the community, as well as culturally competent.^{5,11}</p> <p>Community programming should be aimed at parents at risk including single moms and those of minority children i.e. African American, Native American, and Hispanic.^{5,11}</p> <p>Continuous parental ACE screenings as they can assist the most at-risk parents in supportive interventions, assisting with health outcomes and lowering the risk for future ACEs.^{5,11}</p> <p>Teachers, school social workers, and other parents need to know the signs of strangulation. For example, hoarseness; painful swallowing; visible injuries to the neck or chin and bruising, though bruises may darken for hours or even days; involuntary urination or defecation; involuntary vomiting; and, finally, tiny red spots around the eyes, under the eyelids, or on the face or neck.¹²⁻¹⁴</p> <p>Research and policy work focused on parental behavior change as this is a challenging aspect of injury prevention.¹²⁻¹⁴</p>

Table 6 - Bicycle Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention Opportunities
<p><u>Bicycle</u> A <i>bicycle-related injury</i> is defined as a child being hit by a motor vehicle while on a bicycle, falling off a bicycle, being hit by a bike, and/or a bicycle dropping on a child.^{1,2}</p> <p>Bicycle trips account for only 1% of all ER trips in the United States.^{1,2}</p> <p>Bicyclists face a higher risk of crash-related injury and deaths than occupants in motor vehicles.^{1,2}</p> <p>Children (5-14 years) and adolescents (15-19 years) have the highest rates of nonfatal bicycle-related injuries, accounting for more than 1/3 of all bicycle-related injuries seen in U.S. ERs.^{1,2}</p> <p>In 2014, 242,931 children ages 19 and under were seen in ERs for injuries related to riding bikes.³⁻⁵</p> <p>Every year, 26,000 children are seen in ERs for traumatic brain injury related to bicycle-riding.³⁻⁵</p> <p>Helmets reduce the risk of</p> <ul style="list-style-type: none"> ● head injury by at least 45 %, ● brain injury by 33%, ● facial injury by 27% and ● fatal injury by 29%.³⁻⁵ <p>Of the 67% of high school students who rode a bike in 2013, 88% reported never or rarely wearing a helmet.³⁻⁵</p>	<p>Parents have reported not knowing the facts on proper fitting of helmets for their child, or they had difficulty fitting helmets to their children's head.⁶</p> <p>Lack of adult supervision and lack of adult safety knowledge can result in bicycle-related and traumatic brain injury due to a parent's incorrect assessment of a bicycle injury.^{1,2}</p> <p>Traumatic brain injuries and ACEs leave the child dependent on others for the rest of their lives.³</p> <p>The psychological implications of surviving a bicycle accident can be extremely stressful on a family and the survivor.^{1,7}</p> <p>Parents with ACEs are at an increased risk for neglectful supervision.^{1,8,9}</p> <p>Parental ACEs have been linked to greatly impact a parent's ability to provide a safe, stable, and nurturing emotional environment.^{1,8,9}</p>	<p>People living in the Midwest and South compared to the Northeast are less likely to wear helmets.^{3,5}</p> <p>Helmet use is lower among older children, minorities, and those from a low socioeconomic status.¹⁰</p> <p>Males die 6 times more frequently and are injured 4 times more frequently on bicycles than females.^{1,2}</p> <p>Children with behavioral issues and disabilities are at a heightened risk.^{1,2}</p> <p>Individuals with low socioeconomic status are more dependent on their bicycle¹¹ and are more likely to use roads with higher speed limits.¹²</p> <p>Majority of bicycle deaths occur in urban areas and at non-intersection locations. Patients treated in urban hospitals comprised nearly 95% of hospitalized bicyclists compared with those treated in rural communities.⁴</p> <p>Alcohol involvement increases the chance of a bicycle injury. Among bicyclist deaths, 37% had alcohol involvement either for the motor vehicle driver or bicycle rider.^{1,2}</p> <p>Children at higher risk were those from the following:</p> <ul style="list-style-type: none"> ● families with lower socioeconomic status, ● African-American, ● children from single parent homes, and ● children from indigent neighborhoods where less parental supervision takes place.^{13,14} 	<p>Safe Kids has made some of the recent and evidence-based recommendations:</p> <ul style="list-style-type: none"> ● community based non-legislative interventions, which provide free helmets, can increase the odds of a child wearing a helmet by four times; ● bicycle helmet laws and safe routes to school have been identified as effective ways to reduce bike-related fatalities among children; and as reported by other resources, ● laws requiring the use of a bike helmet has been associated with a significant reduction in the odds of bike-related head injuries in children.^{1,5,6} <p>Wearing reflective clothing decreases likelihood of being in a bicycle accident.^{1,7}</p> <p>Citi planning is a vital component in prevention and reduction in bicycle related injuries and should</p> <ul style="list-style-type: none"> ● focus on low income and urban areas,³ and ● combine the efforts of engineers, planners, pedestrian and bicycle coordinators.¹⁵ <p>Parents of children most at risk, (minority, low SES, low health literacy, single parents) must be made a priority when it comes to education training as well as have numerous resources to be given safe helmets for their child.^{1,8,9}</p> <p>Teachers should be trained in bike safety and bike safety programming should be implemented in schools.^{16,17}</p>

Table 7 - Car-Related Heatstroke Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Heat stroke/Hyperthermia (Car) <i>Heat stroke, or hyperthermia, is a condition that occurs when the body is not able to cool itself quickly enough and the person's temperature exceeds 104°F, making their thermoregulatory mechanism become overwhelmed.</i>¹⁻⁷</p> <p>Common reasons for a child left unattended include the following:</p> <ul style="list-style-type: none"> ● 53% - child was “forgotten” by caregiver ● 29% - child was playing in an unattended vehicle and became trapped ● 17% - child was intentionally left alone when a parent ran a quick errand.¹⁻⁷ <p>Heat stroke deaths of children in cars has risen after laws were mandated to put children in backseats.¹⁻⁷</p> <p>An average of 37 children die every year due to car-related hyperthermia and, for every child who dies, hundreds more are rescued.¹⁻⁷</p> <p>In 2017, 43 car-related heat-stroke deaths were reported.¹⁻⁷</p> <p>87% of children who have died from vehicular heat stroke were 3 years old or younger.¹⁻⁷</p> <p>54% of heat-stroke deaths in vehicles involve children 1 years old or younger.¹⁻⁷</p>	<p>Causing an unintentional injury to a child due to a car-related heat stroke can happen to <i>any</i> parent or caregiver regardless of socioeconomic status.³</p> <p>Roughly 8% of people who were responsible when a child died from heat stroke in a car have been found to be negligent, meaning drugs, alcohol, or a previous interaction with Child Protective Services had been involved.²</p> <p>Mothers and fathers have been shown to be differentially negligent.¹⁻⁷</p> <ul style="list-style-type: none"> ● In cases where a child was forgotten, negligence was due to the father 33% of the time and due to the mother 28% of the time. ● If a child gained access, negligence was due to the mother 44% of the time and the father 12% of the time. ● If a child was knowingly left in the car, negligence was due to the mother 56% of the time and the father 20% of the time. <p>Parental ACEs can have a strong correlation with forgetting a child in a car when linked to stress, sleep deprivation, and daytime fatigue.^{8,9}</p> <p>Children that survive care related heat strokes, or hyperthermia, can suffer permanent brain damage, blindness, hearing loss, seizure, and other serious injuries associated with lifelong impairments and ACEs.^{1,10}</p>	<p>Children are at an increased risk for heatstroke, especially while in a car.¹⁻⁷</p> <p>Car-related heatstroke deaths primarily take place May –September, and accidents peak in July.¹⁻⁷</p> <p>Most deaths occur in the South, followed by the West, Midwest, and Northeast. Texas and Florida report the most total deaths, while Arkansas, Louisiana, and Mississippi report the most per capita deaths.¹⁻⁷</p> <p>Heat stroke deaths are more likely when outside temperatures reach 80° F and above. The temperature inside the vehicle can reach deadly levels in only 10 minutes, even with a window rolled down two inches.¹⁻⁷</p> <p>Infants and children under 4 years old are at the greatest risk for heat-related illness, as they are extremely vulnerable due to immature respiratory and circulatory systems. Children will warm at rates 3 to 5 times faster than adults, and young children cannot escape.¹⁻⁷</p> <p>More than half car related heat-stroke accidents occur at the home. Childcare centers also have a higher incidence of heat-stroke deaths.¹⁻⁷</p> <p>Parents with children that require rear-facing child safety seats are the most at risk as the seats do not look any different to the driver if they are occupied or empty.¹⁻⁷</p> <p>Although these devastating accidents can happen to any parent regardless of socioeconomic background, poverty correlates with a lack of educational awareness, resources and being health literate.^{8,9}</p>	<p>Many prevention efforts have been identified on national, state, and community levels. A successful example is <i>National Heatstroke Prevention Days</i>. These campaigns encourage parents to double check for kids in the backseat of car, set reminders when routines change, and emphasize that this can happen to anyone.^{1, 2,6,11}</p> <p>Parents have reported misconceptions and attitudes towards car heat safety. These misconceptions need to be vital aspects of health-literate programming, as parents need to understand the implications of leaving a child in a car, how hot a car can get, and the biology of heat stroke and cars.²</p> <p>In many instances where a negligent caregiver is prosecuted for a child's heat-stroke death, the judge has made a parent join advocacy groups rather than serve time in jail, to advocate for child heat-stroke safety.³</p> <p>The car industry is incorporating new safety measures to prevent car-related heat strokes.</p> <ul style="list-style-type: none"> ● Some new automobiles can be equipped with systems for alerting the driver if a passenger is in the backseat after the vehicle is turned off.^{1, 2,6,11} ● Car manufacturers have made plans to equip cars with infrared devices to detect any kind of heat and motions.^{12, 13} ● General Motors has developed a child reminder system for its cars, but has only applied it to one of their models.^{12, 13}

Table 8 - Drowning Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p><u>Drowning</u> <i>Drowning</i> is defined as an event in which a child’s airway is submerged in liquid, leading to an impairment in breathing.¹⁻⁵</p> <p>For every child that dies from drowning, another five need to receive emergency care for non-fatal injuries.¹⁻⁵</p> <p>Children ages 1 to 4 have the highest drowning rates, with drowning being the number one reason (behind congenital abnormalities) for death.¹⁻⁵</p> <p>1 in 5 child drowning deaths occur 0-14 year olds.¹⁻⁵</p> <p>50% of drowning victims treated in the emergency department will require hospitalization or will require future care.^{2, 6, 7}</p>	<p>Families with low socioeconomic status and single mothers are associated with lack of appropriate caregivers and supervision.^{2, 3, 8, 9}</p> <p>Dependence on older children for supervision when they are not capable of making appropriate judgments or interventions can result in unintentional drowning.^{3, 4, 7, 8, 10-13}</p> <p>Parental ACEs can result in poor parenting practices, including factors such as neglect.¹³⁻¹⁵</p> <p>The trauma of a near drowning and/or witnessing a sibling or friend in a nonfatal/fatal drowning situation can be traumatizing enough to lead to an ACE in a child.^{2, 6, 7}</p> <p>Unintentional drowning can potentially lead to significant neurological damage,¹⁻⁵ including severe brain damage that may result in long-term disabilities such as memory problems, learning disabilities, and permanent loss of basic functioning (e.g., permanent vegetative state).^{2,6,7} The child can also develop future complications such as pneumonia.^{2, 6, 7}</p>	<p>For children ages 1 to 4, most drownings occur in home swimming pools.¹⁻⁵</p> <p>Children are at risk of drowning in sea, lakes, streams, swimming pools (with and without lifeguards), wells, cisterns, buckets, bathtubs, spas, and garden ponds.^{1-5, 8, 9}</p> <p>Children have a higher risk of drowning in low socioeconomic communities with existing high drowning rates and communities with a high African-American population.^{3, 4, 7, 8, 10-13}</p> <p>Children with a seizure disorder or autism are at a heightened risk for drowning.¹⁻⁵</p> <p>Low-income, African-American males have a disproportionately higher risk of drowning in comparison with White, male children.^{2, 3, 8, 9}</p> <p>Communities with higher immigrant populations, since foreign-born vs. US-born children have a higher incidence of drowning.^{2, 3, 8, 9}</p>	<p>Protective factors that have been identified to reduce children drowning include:</p> <ul style="list-style-type: none"> ● draining unnecessary accumulations of water, ● building safe bridges and installing piped water systems, ● building and maintaining 4-sided fencing around swimming pools, and ● covering wells and rainwater collection sits.^{3,4,7,8,10-13} <p>Culturally appropriate education and program development geared toward parents whose children are at risk of drowning. These programs should include CPR/First Aid training, access to resources such as float devices and ways to build safe barriers around pools.^{3, 4, 7, 8, 10-13}</p> <p>Teach parents and caregivers about the four misconceptions of drowning:</p> <ul style="list-style-type: none"> ● Drowning is loud when in fact drowning is silent; ● Drowning takes a while when in fact drowning is quick; ● A lifeguard will protect my child versus watching your child in the pool is your responsibility; ● Children will get older and teach themselves how to swim versus swim lessons are essential.^{3,4,7,8,10-13} <p>Empower children to learn how to swim using multiple health organizations, and build accessible and safe community pools.^{3, 4, 7, 8, 10-13}</p>

Table 9 - Drug Overdoses Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Drug Overdoses <i>Drug overdoses</i> can occur when a child ingests prescription pills, over-the-counter medications, supplements, and/or a parent's illegal drugs such as cocaine and fentanyl.^{1,2}</p> <p>Unintentional drug overdoses are the leading cause of child poisoning, and instances continue to increase annually.^{2,3}</p> <p>Roughly 165 kids per day, and 60,000 kids per year, are treated in ERs due to accidental and unsupervised medication ingestion.^{1,2}</p> <p>56 children ages 14 and under die annually from unintentional medication overdoses.^{1,2}</p> <p>Of unintentional medication overdose visits to emergency departments, approximately</p> <ul style="list-style-type: none"> ● 95% are caused by a child ingesting medication while unsupervised, and ● 5% are due to dosing errors made by caregivers.^{1,2} <p>Child hospitalizations due to opioid overdoses nearly doubled between 2004 and 2015, from 797 in the first three years of the study to 1,504.⁴⁻⁶</p> <p>43% of children admitted to the hospital for opioid overdose ended up in ICUs.⁴⁻⁶</p> <p>20% of pediatric poisonings involve a grandparent's medication.²</p>	<p>Research has shown a direct link between child maltreatment, increased drug use, poverty, and low socioeconomic status.²</p> <p>There is a correlation between parental ACEs, increased mental illness, and drug use.⁷⁻⁹</p> <ul style="list-style-type: none"> ● The greater the number of ACEs the greater the chance of adult mental illness and drug use.⁷⁻⁹ ● Being on drugs not only affects accessibility to drugs but also the supervision of the child.⁷⁻⁹ ● Parental ACEs heighten the risk for economic insecurity, which is correlated with stress and lack of affordable day care, thus further affecting parental supervision.⁷⁻⁹ <p>Parents who were themselves under the influence of drugs when a child are less likely to take appropriate and timely action.¹⁰</p> <p>Depending on the drug, amount ingested, and the child's size and age, drug overdoses can lead to severe bodily and mental damage and ACEs.^{11,12}</p>	<p>Multigenerational homes are at a greater risk of overdosing, especially among those children living with grandparents.²</p> <p>A study found that young children of mothers prescribed opioids are at a markedly increased risk of overdose. Their risk was heightened when the mother was also on antidepressants.¹³</p> <p>Children who live in working, single family homes are at an increased risk as they pose greater opportunities for lack of supervision.²</p> <p>In general, drug overdoses involve prescribed drugs that have been left in the open vs. illegal drugs that are hidden.¹⁰</p> <p>Children living in low-income areas are at a greater risk for drug overdoses, due to the increased likelihood of parents or neighbors abusing drugs in these communities.²</p> <p>Poverty has been associated with a lack of health literacy and resources to obtain health literacy on awareness and prevention of drug overdoses.²</p> <p>There is no racial or socioeconomic link with opioid abuse.²</p>	<p>The CDC and their coalition of partners provide helpful preventative efforts through:</p> <ul style="list-style-type: none"> ● the <i>Up and Away and Out of Sight</i> educational program that educates parents and other caregivers about medication safety and ● focusing on policies that focus on the "3 S's"- Safer packing, Safer use, and Safer storage.² <p>Specific prevention and policy guidelines should focus on:</p> <ul style="list-style-type: none"> ● Storing medicine in a place that children cannot reach, ● Teaching children that medicine is dangerous, ● Never equating medication with candy in an effort to get kids to take their doses — it's bound to confuse them, and ● Teaching grandparents, especially those older with different memory issues, about the importance of safe practices.¹ <p>Parental education should be a priority and should include:</p> <ul style="list-style-type: none"> ● Sending home safety instructions ● Engaging in community wide outreach ● Government regulation and monitoring, and ● More funding/poison control structure.² <p>Prescribers should take extreme measures to provide information on safe storage and prompt disposal of unused opioids and prescribe the smallest effective dose.¹³</p> <p>There should be more policy, prevention, and state-by-state jurisdiction of cases of both overdosing and being in the presence of parents who are manufacturing home-made drugs such as methamphetamines.^{14,15}</p>

Table 10 - Falls Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Falls The main types of falls include:</p> <ul style="list-style-type: none"> ● Falling out of windows/off of balconies, ● Falling from playground equipment, ● Falling off furniture, ● Falling down stairs, ● Falling from a bunk bed, ● Being dropped by a caretaker, and ● Slips in a bathtub.¹ <p>Falling is one of the top-ranked unintentional childhood injuries, accounting for more than half of nonfatal injuries.²</p> <p>In 2003, more than 2.3 million children aged 14 and under were treated in hospital emergency rooms for fall-related injuries.²</p> <p>Children aged 4 and under are at the greatest risk for falls, accounting for 56% of fall-related deaths and more than 40% of fall-related injuries.²</p> <p>More than 80% of fall-related injuries among children aged 4 and under occur in the home.²</p> <p>9% of fall-related injuries associated with products (e.g., baby walkers, windows, playground equipment) result in hospitalization - more than 2 times the hospitalization rate of all other product-related injuries.²</p> <p>Males are more than twice as likely as females to die from fall-related injuries.²</p> <p>Children with disabilities who are minimally mobile may be at increased risk of falling.²</p> <p>Falls from windows have been reported as one of the most commonly occurring types of fall injuries.²⁻⁵</p>	<p>Parental ACEs:</p> <ul style="list-style-type: none"> ● Heighten a parent’s lack of supervision as well as knowledge of safety literacy and child development. ● Put their child at risk as parental ACEs may greatly influence a parent’s ability to provide a safe, stable, and nurturing emotional environment. ● Heighten alcohol and drug abuse, which can lead to unsupervised situations. ● Greatly affect a parent’s ability to access health care and understand health literacy regarding fall-related injuries.⁶⁻¹³ <p>Parents with low socioeconomic status lack safety knowledge, as well as child-development knowledge.¹⁴⁻¹⁶</p> <p>Parents report not supervising their boys as much, even though boys engage in riskier activities and are at a greater risk of falls.¹⁴⁻¹⁶</p> <p>Falls can result in traumatic brain injury, spinal cord injuries, major fractures, and psychological trauma, which can cause life-long problems and ACEs for the victim.^{4, 5, 17}</p>	<p>Most injuries take place during the Spring and Summer months.^{2, 18-20}</p> <p>Children in communities with the following characteristics are more likely to receive a fall-related injury: low-income housing, African-American and/or Hispanic, multi-story and apartment building, windows without barriers, playgrounds, and urban.^{1, 2, 4, 21-24}</p> <p>Falls at the home have more severe consequences versus falls in other locations, such as a daycare.¹</p> <p>Surfaces with hardwood or concrete correlate with more severe head injuries.^{4, 5, 17}</p> <p>In homes with stairs, babies aged 12 to 18 months of age are at the highest risk of falling down the stairs.^{2, 25}</p> <p>Falls account for approximately 80 percent of all playground-related injuries and more than one-fifth of fatalities.^{2, 18-20}</p>	<p>Interventions and programming should be multifaceted, with an emphasis on policy and evidence-based approaches.⁴</p> <p>Investigations must be made into injuries related to falls, as they are a sign of physical child maltreatment (e.g., shaken baby syndrome).^{4,5,17}</p> <p>Prevention plans should focus on a training program</p> <ul style="list-style-type: none"> ● geared toward parents with ACEs, ● for supervisors and children, ● with a system for reporting injuries and injury documentation, and ● Providing annual evaluations.^{2,18-20} <p>Prevention policies should make sure children from low socioeconomic backgrounds are provided with the following:</p> <ul style="list-style-type: none"> ● Continuous safe playgrounds, ● Numerous safety equipment evaluations, ● Baby walker safety education, and ● Access to window barriers.^{2,4,18-20,25} <p>New York City’s successful “Children Can’t Fly” prevention program included educational messages and new laws and building codes targeted to low-income and minority families living in older apartment buildings.²⁻⁵</p>

Table 11 - Fire and Burn Injuries Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Fire and Burn Injuries <i>Fire and burn injuries</i> are mostly due to fires, but can also occur due to a child coming into contact with hot materials, with chemical burns, and with electrical burns.¹⁻³</p> <p>Children are particularly susceptible to fire and burn injuries because:</p> <ul style="list-style-type: none"> • their skin is thinner and so they burn more quickly and deeply, • they suffer more greatly from fire inhalation, and thus suffer respiratory failure due to immature immune systems, and • they are more likely to suffer from sepsis due to their immature immune systems.¹⁻³ <p>Fire and burns are one of the leading causes of death and injury for children in the home.¹⁻³</p> <ul style="list-style-type: none"> • Children 0 to 3 years of age are at the greatest risk of death as they are not able to escape from a fire.¹⁻³ • Children 3 to 5 years of age are more likely to create a fire.¹⁻³ 	<p>Fire and burn injuries and fatalities result in ACEs for the victim and the victim's friends and/or siblings.¹⁻⁴</p> <ul style="list-style-type: none"> • Burn treatments are one of the most serious of medical treatments, leaving children emotionally damaged and physically disfigured with high pain levels and irregular growth of scar tissue due to their developing bodies.^{1,4} • Hospitalizations due to burns are for long periods of time and result in missed school and educational milestones, as well as delays in important developmental social contexts.^{1,4} <p>Parental ACEs greatly influence the inadequate supervision of a child. Children are at a heightened risk when</p> <ul style="list-style-type: none"> • parents are impaired from use of alcohol or other drugs, • Parents have physical or mental disabilities, • the mother is stressed or depressed, or • there is acute family stress and lack of external support.^{1,2,4-6} 	<p>Fire and burn-related deaths are lowest in the summer and highest in the winter.¹⁻³</p> <p>Communities with a higher number of smokers are more at risk for fires.¹⁻³</p> <p>Neighborhoods with higher family violence and drug-related crimes also have a higher incidence of arson deaths.^{1,2,4-6}</p> <p>The highest prevalence rates of fire/burn deaths and injuries occur in households that:</p> <ul style="list-style-type: none"> • have low socioeconomic status,^{1-3,5,7,8} • have male children,¹⁻³ • are in a predominantly African-American, Alaskan/Native American, or immigrant community,¹⁻³ • are in a mobile home or rural community,^{2,3,5,7,8} • are close to vacant and/or abandoned buildings,^{2,3,5,7,8} • have a single parent, and/or^{2,3,5,7,8} • are located in the South of the United States.^{2,3,5,7,8} <p>Burn injuries take place primarily in kitchens and bathrooms.¹⁻³</p>	<p>Essential safeguards for fire and burn injuries include:</p> <ul style="list-style-type: none"> • checking water temperature, • family fire and emergency exit plans, and • making sure smoke detectors are working properly.^{1,4,7} <p>Partnerships with local fire departments that include multilingual programs for:</p> <ul style="list-style-type: none"> • parent and child safety education, • assistance with smoke alarm giveaways and installations, • discouraging careless smoking, • match and lighter safety for children, • water temperature safety, • kitchen safety, and • minority parents with low socioeconomic status.^{1,2,4,6} <p>Community programs geared toward fire and burn safety should:</p> <ul style="list-style-type: none"> • be free, • be geared toward single mothers, • be mobile and include home visits, and • address the dangers of vacant and/or abandoned buildings in the community.^{1,2,4,6}

Table 12 - Front and Back Rollovers Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p><u>Front and Back Rollovers</u> <i>Front and back rollovers</i> are unintentional injuries that occur due to the front and back movement of a car.¹⁻⁶ These injuries correlate with pedestrian and unrestrained motor vehicle accidents.</p> <p>2,400 children annually, or 50 weekly, are injured due to the front and back movement of a car.¹⁻⁶</p> <p>2 children die every week due to front and back rollovers.¹⁻⁶</p> <p>96% of backing fatalities involve children under the age of 5.¹⁻⁶</p> <p>Most victims of front and back rollovers are between the ages of 12 and 23 months.¹⁻⁶</p> <p>70% of incidents involve a parent behind the wheel.¹⁻⁶</p>	<p>Children that are injured from front and back rollovers endure a range of both physical and cognitive injuries.¹⁻⁶</p> <p>Front and back rollovers create ACEs in the surviving child as well as siblings and friends of the victim.¹⁻⁶</p> <p>Front and back rollovers generally involve a lapse in supervision and/or negligence while returning from or leaving for a trip.¹⁻⁶</p> <p>Parental ACEs associated with stress, drug and alcohol abuse, and other determinants that may interfere with child supervision can lead to negligence and a front and back rollover incident.¹⁻⁶</p>	<p>All ranges of demographics are affected by unintentional injuries due to front and back car rollovers.⁵</p> <p>Communities with low-income and low health literacy households are at a higher risk for front and back rollovers.¹⁻⁶</p> <ul style="list-style-type: none"> ● Low-income families cannot afford new cars with safety devices and features that could prevent front and back rollovers. ● Families with low incomes and low health literacy may not be able to afford putting fences around garages and/or parking spots or learn how these features can help prevent front and back rollovers. <p>Communities and neighborhoods with higher numbers of larger cars that have more blind spots, such as SUVs, minivans, and pickup trucks, are more likely to have back and front rollover incidents.¹⁻⁶</p>	<p>Educate parents to be aware that, when the parent or another loved one leaves, the child could try to follow them.¹⁻⁶</p> <p>Health literacy and cultural competence should be incorporated and reiterated in multiple capacities.⁵</p> <p>Recommended rules to follow to avoid front and back rollovers⁵:</p> <ul style="list-style-type: none"> ● Do a thorough walk around of the vehicle before getting in and driving away. ● Know the blind zones of the vehicle you are driving. ● Never back up the vehicle in a hurry. ● Keep driveway and vicinity around it clear of toys, balls, sports equipment, etc. ● Hold toddlers and young preschoolers when someone is backing out of the driveway. <p>Safeguards should include implementation of community structures that separate cars (e.g., fences) and policies that require rear cameras and audible automobile warning signals.¹⁻⁶</p>

Table 13 - Pedestrian Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention Opportunities
<p>Pedestrian <i>A pedestrian injury of a child is defined as an injury to a child who is walking or running, primarily in an area with vehicles, and is injured by a vehicle.¹</i></p> <p>In 2015, 246 children died from a pedestrian injuries.²⁻⁷</p> <p>In 2014, 40,000 children suffered from non-fatal pedestrian injuries.²⁻⁷</p> <p>80% of child pedestrian deaths occur at non-intersection locations.²⁻⁷</p> <p>Teens have a death rate twice that of younger children and have accounted for half of all child pedestrian injuries in the past five years.²⁻⁷</p> <p>Children from birth to age 2 are more likely to suffer non-traffic related pedestrian injuries, including those occurring in driveways, in parking lots, and on sidewalks.²⁻⁷</p> <p>Male children are more likely than female children to die from or receive pedestrian injuries.²⁻⁷</p> <p>Children aged 5-9 years are at high risk for pediatric pedestrian injuries due to their not fully developed cognition.²⁻⁷</p>	<p>Pedestrian injuries can be extremely traumatic and can lead to ACEs in children or children exposed to the incident. Pedestrian injuries can result in severe bodily harm such as traumatic brain injury and cervical spine trauma. In many cases, the child will also suffer PTSD and depression. The death or injury of a child can greatly impact the community and family members. If the child dies, it will greatly impact family members and siblings, creating tremendous feelings of psychological grief. If the child survives, it will impact the community and family financially, as well as impact family cohesiveness.²⁻⁷</p> <p>Parents who have ACEs put their child at risk, as parental ACEs have been linked to greatly impacting a parent's ability to provide a safe, stable, and nurturing emotional environment. Parental ACEs also heighten alcohol and drug abuse, which can lead to unsupervised situations.²⁻⁷</p> <p>Behaviors associated with child neglect, such as aggression and trouble externalizing problems, are risk factors for child pedestrian injuries.²⁻⁷</p> <p>In many instances where parents trust older children to watch younger children, these latter children are not cognitively capable of understanding traffic safety themselves.²⁻⁷</p>	<p>Pedestrian injuries occur most often during:</p> <ul style="list-style-type: none"> ● rush hour (3 to 6 PM), ● the months of May and October, ● weekends during the summer months, and ● during the day versus at night.²⁻⁷ <p>Pedestrian injuries primarily involve:</p> <ul style="list-style-type: none"> ● male drivers between the ages of 16 to 25, ● alcohol, ● distracted driving, and/or ● reckless driving.²⁻⁷ <p>A higher incidence of pedestrian injuries occur in communities that:</p> <ul style="list-style-type: none"> ● are urban and/or high-density areas, ● lack proper crosswalks and sidewalks, ● have a higher number of children that own cell phones (and hence create more distractions), ● have a low socioeconomic status, ● have a higher number of low-income households, ● have households with a single parent, ● have overcrowded households, ● lack proper playgrounds and parks, ● are plagued by violence, and ● lack quick emergencies services.²⁻¹⁵ <p>African-American children have the highest death rate, followed by Hispanic children and American Indian/Alaskan Native children.²⁻⁷</p> <p>White children and Asian children have the lowest rates of pedestrian injuries.²⁻⁷</p>	<p>Successful implementation of safeguards will incorporate a multi-dimensional approach that incorporates city planning and prioritizes at-risk parents, especially those with ACEs.^{2,5,8-15}</p> <p>Safe Kids has developed a successful multi-dimensional pedestrian injury prevention plan with the goals of:</p> <ul style="list-style-type: none"> ● Reduced child risk of injury while walking, ● Increased child physical activity level, and ● A more pedestrian-friendly environment.^{2-5,7,10,16-18} <p>The six main components of the plan include:</p> <ol style="list-style-type: none"> 1. Enhance public awareness about the need to improve safety for child pedestrians while promoting the health and environmental benefits of walking. 2. Modify the behavior and attitudes of both pedestrians and drivers to improve sharing the road. 3. Modify the physical environment to better support pedestrian traffic. 4. Develop and conduct effective safe-walking programs. 5. Conduct research to address gaps in knowledge and to translate research findings into effective programs and public policy. 6. Conduct research to address gaps in knowledge and to translate research findings into effective programs and public policy.^{2-5,7,10,16-18} <p>Successful school-based programming geared toward different age groups and situations include: WalkSafe, Child Pedestrian Injury Prevention Project (CPIPP), and Cyrus the Centipede.^{2-5,7,10,16-18}</p>

Table 14 - Penetrating Injury Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Penetrating Injury A <i>penetrating injury</i> is defined as an injury that occurs when an object pierces the skin and enters a tissue of the body, creating an open wound.¹⁻³</p> <p>Penetrating injuries account for less than 5% of admissions to children’s trauma centers.¹⁻³</p> <p>Primary causes of penetrating injuries are gunshot and knife stab wounds.¹⁻³</p> <p>Penetrating injuries can also be caused by nails, metal picks, keys, pencils, scissors, power drills, etc.¹⁻³</p> <p>Penetrating injuries that don’t involve guns or knives are:</p> <ul style="list-style-type: none"> ● extremely rare and accidental and ● are reported at a higher incidence in 3 –6-year-old males.⁴⁻⁷ <p>Boys are affected in 82% of intentional penetrating gun injury or homicide reports involving children between the ages of 0 – 18.^{8,9}</p> <p>90% of ocular penetrating injuries are preventable.⁴⁻⁷</p>	<p>Penetrating injuries can be extremely severe and detrimental to the child’s life physically and emotionally.¹⁰</p> <p>A child’s penetrating injury can impact their friends and siblings by creating an ACE.¹⁰</p> <p>Penetrating injuries correlate with domestic violence (DV).¹⁰</p> <ul style="list-style-type: none"> ● DV is an indicator of child maltreatment.¹⁰ ● DV is also associated with other indicators of child maltreatment such as drug and alcohol abuse, low income level, unemployment, cohabitation of unmarried partners, etc.¹⁰ <p>Negligence and bad supervision are associated with <i>Optimal Bias</i>, the self-assurance that “it’s not going to happen to me.”¹¹</p> <p>Parental negligence puts children with penetrating injuries at risk for secondary injuries due to improper care.⁴⁻⁷</p>	<p>Penetrating injuries primarily take place in a residential setting.¹⁻³</p> <p>Predominantly African-American communities, since African-Americans are most at risk for penetrating gun injuries.^{8,9}</p> <p>Communities with a higher incidence of domestic violence, gang and violent crimes, and drug use.^{8,9}</p> <p>Communities with higher incidences of household characteristics related to negligent parenting, such as:</p> <ul style="list-style-type: none"> ● families with a low socioeconomic status, ● lower level of education, and ● single parent households.^{4-7,11-14} 	<p>Implementation of policies that allow the sharing of information between doctors, law enforcement, and child services so that the possibility of child abuse and/or neglect can be investigated.³</p> <p>Multidimensional parenting classes that focus on:</p> <ul style="list-style-type: none"> ● child-proofing the home, ● not asking children to perform tasks that can be dangerous for them, ● keeping sharp objects out of the reach of children, ● using shatter-resistant glass and/or padding storm doors and windows that can potentially break, ● close supervision of small children, and ● disposing of firearms in the house, etc.^{3,10} <p>Parenting classes that encourage closer supervision of boys instead of girls, since boys are at a higher risk of unemotional penetrating injuries.¹⁵</p> <p>Development of safer knife designs that incorporate features such as a closing mechanism is a potential solution to decreasing unintentional penetrating injuries.^{16, 17}</p>

Table 15 - Poisoning Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Poisoning <i>Poisoning</i> occurs when a child ingests a chemical substance that can kill, injure, and/or severely impair his or her body.¹</p> <p>Every day, over 300 children ages 0-19 are treated in ERs for poisoning due to the ingestion of chemicals from clearly marked household cleaners and make-up²</p> <p>652 children ages 19 and under died from unintentional poisoning in 2013, of which</p> <ul style="list-style-type: none"> ● 88% were drug related, ● 90% were between 15 and 19 years old, and ● 71% were boys.³ <p>119,003 children ages 19 and under were seen in ERs for non-fatal poisonings in 2013.³</p> <p>67,700 children ages 4 and younger were seen in ERs for accidental medication exposure, of which 12,390 required hospitalization.³</p> <p>Children between 13 to 14 months are most frequently seen in ERs, accounting for 68% of visits.³</p> <p>9 out of 10 poison exposures in children occur in the home.³</p> <p>50% of the 2 million calls to poison control centers in 2012 were for exposure and ingestions among children ages 5 and under.³</p> <p>In a study, 80% of children eligible for Medicaid had an increased blood lead concentration.⁴⁻⁸</p>	<p>Due to their small size and immature organs, children can suffer permanent damage and lifelong disabilities due to poisoning, which results in ACEs.⁹</p> <p>The permanent and lasting effects of poisoning on a child can affect social function and future employment and earnings.⁴⁻⁸</p> <p>Single mothers with multiple children are less likely to provide the appropriate child supervision that's necessary for poison prevention.^{10, 11}</p> <p>Munchausen Syndrome by Proxy (MSP) is a disorder in which the caregiver of a child either makes up symptoms or causes symptoms to make it appear as though the child is injured or ill.^{12,13}</p> <ul style="list-style-type: none"> ● This mental illness is also considered a form of child maltreatment.^{12, 13} ● Children under the age of 6 are most likely to have a caregiver with MSP.^{12, 13} ● The caregiver is usually the victim's mother, is usually married, and has additional mental disorders, such as depression.^{12, 13} 	<p>Winter months have a higher incidence of carbon monoxide poisoning due to use of heaters, fireplaces, and gas appliances in unventilated areas.^{14, 15}</p> <p>Communities with outdated water infrastructures are more at risk for lead poisoning through the water supply.⁴⁻⁸</p> <p>Communities with older and low-income homes are more likely to have buildings that contain lead.⁴⁻⁸</p> <p>African-American, Mexican-American, and immigrant children are disproportionately affected by lead poisoning.⁴⁻⁸</p> <p>Children from a low socioeconomic background and living below the poverty level are more likely to have elevated blood lead levels.⁴⁻⁸</p>	<p>The CDC promotes the following prevention information while building awareness and educating parents and caregivers regarding proper medication and chemical storage:</p> <ul style="list-style-type: none"> ● lock them up and keep them away from children, ● know the number, ● read their labels, and ● do not retain if they are not needed.² <p>Identifying and treating iron deficiency, as well as maintaining a healthy diet, are important in decreasing a child's vulnerability to lead poisoning.⁴⁻⁸</p> <p>Awareness education for sources of lead and resources for de-leading older homes in low-income communities.⁴⁻⁸</p> <p>More research is necessary to better identify what community factors are more highly correlated with unintentional poisonings.⁴⁻⁸</p> <p>Community poison prevention programs geared toward single mothers with low socioeconomic background and multiple children.^{10, 11}</p> <p>The elimination of distractions and storage below 150cm have been associated with the prevention of 13% and 19% of childhood poisonings, respectively.^{10, 11}</p>

Table 16 - SUID Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p><u>Sudden Unexpected Infant Death (SUID)</u> <i>Sudden Unexpected Infant Death, or SUID, is the death of an infant younger than 1 year of age that occurs suddenly and unexpectedly.</i>¹⁻³</p> <p>The three most commonly reported types of SUID are SIDS, unknown cause, and accidental suffocation and strangulation in bed.</p> <p>Unsafe sleep environments are a leading cause of infant suffocation and strangulation.</p> <p>SUID is the leading cause of injury-related death among babies between 1 month and 1 year of age.¹⁻³</p> <p>Most SUID deaths occur in babies between 1 month and 4 months of age.¹⁻³</p>	<p>Neglectful supervision can be associated with infant suffocation if they are sharing a sleep surface with an intoxicated caregiver at the time of their death.</p> <p>SUID can occur due to accidental or non-accidental trauma.¹⁻³</p> <p>Babies born pre-term, low birth rate, or displaying other indicators of improper pre-natal care are at risk for SUID and/or child maltreatment.¹⁻⁷</p> <p>Adverse social circumstances play a significant role in Sudden Unexpected Infant Death.^{6, 8-11}</p> <p>Parents who are stressed, use tobacco, or abuse substances such as alcohol or drugs have also been found to put their baby at greater risk for SUID.¹⁻³</p> <p>The death of a baby due to SUID is an ACE for the infant’s siblings, which can have long-term negative health implications for them.¹⁻³</p>	<p>Social norms supporting unsafe sleep environments for infants can contribute to suffocation-related SUID fatalities.</p> <p>Communities with a higher number of new parents that are teenagers or over 35 years old. Babies with such parents are at a higher risk for SUID.^{2, 4-7}</p> <p>Communities with babies in families with low socioeconomic status, maternal young age, low maternal education, single marital status, infants who do not live with their father have a 50% higher chance of dying from SUID.^{2,4-7}</p> <p>Communities with higher incidence of parental tobacco use.^{6, 8-11}</p> <p>Certain races and ethnicities are impacted more by SUID:</p> <ul style="list-style-type: none"> • From highest to lowest: American Indian/Alaska Native, Non-Hispanic black, Non-Hispanic white, Hispanic, Asian.^{2,4-7} • Non-Hispanic black infants have significantly higher rates of characteristics associated with SUID, such as low birth-weight, pre-term birth and infant mortality compared to Non-Hispanic infants.^{2, 4-7} 	<p>Pacifier use for infants up to 1 year of age has been found to be a protective factor for SUID.^{3, 11-17}</p> <p>Greater access to resources, including safe sleep spaces for infants, for the most vulnerable and at risk populations: African –Americans, Native –Americans, young mothers, and parents with ACEs.^{3, 11-17}</p> <p>A multidimensional approach (policy, social workers, OB-GYNs) that includes information on safe sleep, safe breastfeeding, pre-/post-natal care, information on room sharing, myths about “safe” bed sharing, importance of proper sleep surfaces, etc.^{3,11-17}</p> <p>The national SUID rate declined considerably following the release of campaigns promoting safe sleep environments.</p> <p>The CDC’s guidelines for investigating SUID deaths help to clarify the cause of infant deaths, thereby informing prevention opportunities. Sudden Unexplained Infant Death Investigation Reporting Form</p>

Table 17 - Unrestrained Motor Vehicle Summary - Child Injury Indicators as Risk Factors for Child Maltreatment

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Unrestrained Motor Vehicle <i>Unrestrained Motor Vehicle (UMV)</i> is defined as a passenger (child) in a motor vehicle crash who was not using a safety belt or was not placed in a proper child safety seat.¹⁻⁶</p> <p>UMV is the leading cause of unintentional injury fatalities in children.¹⁻⁶</p> <p>Unrestrained children are 3.5 times more likely to be seriously injured in a crash than restrained children.¹⁻⁶</p> <p>In one year, more than 618,000 children ages 0-12 rode in vehicles without the use of a child safety seat, booster seat, or a seat belt at least some of the time.¹⁻⁶</p> <p>In 2015, 35% of children 12 years old and younger who died in a crash (for which restraint use was known) were not buckled up.¹⁻⁶</p> <p>From 2001 to 2010, approximately 20% of child (<15 years old) passenger deaths in the U.S. involved drunk driving.¹⁻⁶</p> <ul style="list-style-type: none"> 65% of the time, it was the child's own driver that had been drinking. 61% of child passengers of drunk drivers were not buckled up in the fatal crash. 	<p>UMV accidents can lead to extreme morbidities such as spinal cord injuries and traumatic brain injuries (TBIs). Children can also endure life-long psychological effects. 25% of children who suffered from traffic injuries, and 15% of their parents, were later diagnosed with post-traumatic stress disorder. Surviving a UMV injury can result in life-long physical and emotional trauma and associated ACEs.¹⁻⁶</p> <p>Parental ACEs greatly impact a parent's ability to provide a safe, stable, and nurturing emotional environment. Parental ACEs also heighten alcohol and drug abuse, which can lead to unsupervised and negligent situations.⁷⁻¹⁰</p> <p>Parental ACEs greatly affect a parent's ability to access health care and understand health literacy. This results in a lack of knowledge about air bag safety and weight requirements.^{7-10,11}</p> <p>Although 96% of parents believe they install and use their car seats correctly, nearly 73% of car seats are misused in at least one way critical enough to compromise their effectiveness.¹⁻⁶</p>	<p>Parents of all socioeconomic backgrounds and education levels have misconceptions about child motor vehicle safety.¹²⁻¹⁵</p> <p>Rural areas have higher motor vehicle crash incidence rates and death rates than urban areas, with crashes in rural areas tending to be more severe.¹⁻⁶</p> <p>Communities with higher poverty levels have more instances of UMV injuries due to older and more poorly maintained vehicles, lack of safety glass, collapsible steering columns, lack of availability and access to resources, literacy programs, etc.^{2, 3, 16, 17}</p> <p>Communities with a higher number of larger cars are likely to have a higher incidence of UMV-related child injuries. The size of the car impacts the type of accident, and higher riding vehicles (e.g., SUVs) have a greater effect on a child's chest and head compared to those of an adult.¹⁻⁶</p> <p>Areas with a higher incidence of drunk drivers and/or DUIs correlate with UMVs, since nearly half of UMV injuries are vehicles with drunk drivers.¹⁻⁶</p> <p>In 2009-2010, among children aged 12 and under, more African-American (45%) and Hispanic (46%) children were not buckled up compared with White (26%) children.¹⁻⁶</p> <p>In 2015, in accidents with known restraint use, older children were less likely to be buckled up. 43% of 8-12-year-olds were not buckled up compared with 36% of 4-7 year olds and 26% of <4 year olds.¹⁻⁶</p>	<p>Safeguards that reduce UMV child injuries must be multidimensional, simple, and clear, culturally competent, specific, and address parental misconceptions.^{7-10,12-16}</p> <p>Successful programs targeted at the reduction of UMV child injuries include:¹⁸</p> <ul style="list-style-type: none"> contingency management (negative and positive reinforcement, punishment, feedback, record keeping and contracts), counseling and face-to-face instruction, bibliotherapy (information and education), and modeling and demonstration. <p>Examples of successful campaigns include the following:</p> <ul style="list-style-type: none"> Toyota's "Buckle up for Life" worked directly with parents, caregivers, and kids to provide free car seats through local churches and hospitals and provided educational information through safety experts.¹⁹ The "Buckle up" campaign provided free car seats and certified expert installation to at-risk families, as well as emphasized child passenger safety (addressed car seats, booster seats, and seat belts), passenger education for pre-teens and teens, and a public education on driveway and parking lot injuries.²⁰ <p>Preventative legislation and programs should encourage proper and persistent child restraints: ¹⁻⁶</p> <ul style="list-style-type: none"> Booster seats lower child injuries in crashes by 59%. Car seats reduce the risk of death by 71% in infants and 54% in 1-4 year olds. 182,000 injuries could be prevented annually if all 0-14 year olds were properly restrained.

Table 18 - *Weapon Summary - Child Injury Indicators as Risk Factors for Child Maltreatment*

Indicator, Definition, and Statistics	Association with Child Maltreatment	Spatial Influences	Protective Factors and Prevention opportunities
<p>Weapon <i>A Weapon</i> is any object that is designed or used for inflicting bodily harm or physical damage.¹</p> <p>Guns are one of the most deadly weapons discussed here.</p> <p>1/3 of US households with children have guns.²⁻⁶</p> <p>9 out of 10 unintentional shooting fatalities take place in a home.²⁻⁶</p> <p>Annually, 1,300 children die and 5,790 are wounded from gunshots.²⁻⁶</p> <p>Boys are 4.5 times more likely to be shot than girls.²⁻⁶</p> <p>76% of children aged 5-14 said they knew where their parents' gun was stored, while parents reported that only 39% of children knew where the gun was stored.^{3,7}</p>	<p>Parents that have ACEs are at a higher risk of negligent supervision due to:</p> <ul style="list-style-type: none"> ● alcohol and drug use, ● higher stress, ● low education levels, and ● low socioeconomic status.⁸⁻¹² <p>Young parents have a higher risk of low education and socioeconomic status and higher stress and negligent parenting.^{4, 13, 14}</p> <p>Negligent parenting puts kids at high risk for gun related injuries, due to their:</p> <ul style="list-style-type: none"> ● innate developmental curiosity⁵ and ● ability to pull a trigger as young as 4 years old.^{3,7} <p>Youth are at great risk for emotional distress from the effects of gun violence: PTSD, hindered brain development, high levels of anger, sleep distortion, despair, psychic numbing, hopelessness, truncated moral development, and ACEs.²</p>	<p>Gun related incidents rise during weekend and summer months.²⁻⁶</p> <p>Communities with an increased number of homes with guns, since 9 out of 10 unintentional shooting fatalities take place in a home.²⁻⁶</p> <p>Rural communities in the Midwest, Western, and Southern states with a higher number of middle-aged men. These are the characteristics of the average gun owner in the United States.^{2-6,13,14}</p> <p>Communities with a higher number of young parents:</p> <ul style="list-style-type: none"> ● Young parents have a higher likelihood of low education levels and low socioeconomic status and higher stress and negligent parenting.^{4,13,14} ● The most common characteristic of shootings is that the parent supervising the child is in their early- to mid-20s.²⁻⁶ <p>Community characteristics associated with urban gun ownership:</p> <ul style="list-style-type: none"> ● Gang-related and criminal activity and ● Primarily African-American and Hispanic neighborhoods.² 	<p>A multidimensional campaign approach that educates parents who lack gun-safety knowledge and are at risk for negligence.^{3, 4,8,15}</p> <p>States that have Child Access Prevention (CAP) Laws have been associated with reductions in nonfatal gun injuries among children under the age of 18.¹⁶⁻¹⁸</p> <p>Introducing in high-risk communities the ASK campaign, which encourages parents to ask other parents if there is a gun in the house before children visit.^{3, 4,8,15}</p> <p>Interventions should also focus on fathers, since males are more likely to own a firearm, and should encourage mothers to learn about gun safety and guns in the house.^{4, 13, 14}</p> <p>Parental intervention programs and policy should account for geographically-based differences in gun culture.^{4, 19-21}</p> <p>Safeguards should address the unique barriers of rural community interventions to treating mental health issues such as transportation.^{4, 19-21}</p>

Methodology Write-up

The framework we have developed and describe below is very much based on a traditional machine learning workflow. However, from a spatial analysis perspective, predicting unknown quantities across space from observed sample data is typically known as ‘interpolation.’ In their exhaustive review, Li and Heap situate this brand of spatial prediction in the realm of ‘spatial interpolation,’ suggesting that ‘nearly all spatial interpolation methods can be represented as weighted averages of sampled data.’¹

Methodological literature at the intersection of interpolative predictive modeling and geography include simple interpolation, geostatistical methods such as Kriging, Gaussian Process Regression, Geographic Weighted Regression, Generalized Linear Models, and nonlinear models like Random Forests.² These models have been applied across a variety of disciplines including forestry, soil science, biology, archaeology, criminology, and public health,³ and a compelling thread of literature on the validation of spatial prediction methods including Congalton, Vicente-Serrano et al., Li and Heap, and Brenning.⁴ Decades of literature chronicle machine learning techniques, which vary from geostatics but are mechanically similar, including Kuhn and Johnson and Hastie, Tibshirani, and Friedman.⁵

The first application of these techniques to predict child maltreatment employed The Risk Terrain Model (RTM).⁶ The original RTM model used a weighted raster overlay methodology rooted in ‘Map Algebra,’ a method first presented by Tomlin.⁷ While this is a useful descriptive approach for generating spatial hotspots, it does not provide measures of statistical confidence or goodness of fit.

The RTM approach matured from a geographical overlay into a more prescriptive machine learning workflow as part of a partnership with Jeremy Heffner and software development firm Azavea. The Risk Terrain Modeling Diagnostics Utility tool (RTMDx) used regularization to reduce potential collinearity when predicting crime counts.⁸ Heffner developed a novel feature-selection approach combining penalized regression and stepwise regression to estimate a final Poisson regression model that predicts crime counts.

The RTMDx statistical workflow was developed using open source statistical packages in R. While the analytics that underlie the RTMDx analytical engine are open source, the utility itself is not. RTMDx ranges from \$100/year for a student license to \$4,995/year for ‘Agency Users.’¹⁵ The RTMDx suite is one of several closed predictive policing software packages. Others include PredPol and HunchLab.

We view the methodology developed for this project as a close cousin of Heffner’s model with some key differences. First, all the software and routines documented here are open source. Second, we developed not just a machine learning model, but an entire workflow designed to help stakeholders move from unstructured data to actionable intelligence. A host of Extract, Transform, and Load tools have been developed for the purposes of data ingestion, cleaning, and standardization. In addition, several Exploratory Data Analysis routines have been created to describe key relationships in the data, many of which can be visualized and explained to non-technical policy makers. Finally, a host of comprehensive, machine learning specific tools have been generated for the purposes of both prediction and prediction assessment. We look at each in turn below.

ETL & Feature Engineering

Feature engineering is the creation of standardized observations from which predictive relationships can be mined. The process of feature engineering includes the steps of data ingestion, aggregation, and transformation. As Table 19 shows, we employ several datasets for this stage of the analysis, converting each into a series of individual features.

Table 19

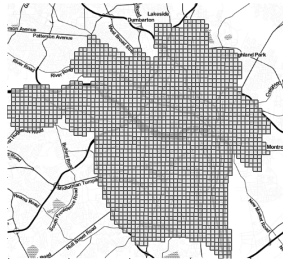
Dataset	Description
Crime	Locations of reported violent and nonviolent incidents that represent risk in the city
Points of Interest	Places in Richmond that characterize environmental factors that are categorized as either risk (i.e., pawnbrokers, payday loan locations, ABC stores) or protective (i.e., libraries, community centers, grocery stores) features
Businesses	Businesses that either characterize nuisance land uses or protective land uses
Code Violations	Measures indicative of the safety and overall quality of structures
CPS Accepted Events	Location of child maltreatment incidents

Routines were developed to load data from various files and in various formats into the R programming environment for standardization and reshaping. Thus, this step begins with moving all data files to a common folder and then using R to list the files, check for the presence of ID and spatial coordinate fields, and identify the numbers of rows and of columns in each data file. A custom R function was written to handle these steps automatically, regardless of file type or file names. Once loaded, summary statistics on each dataset are generated.

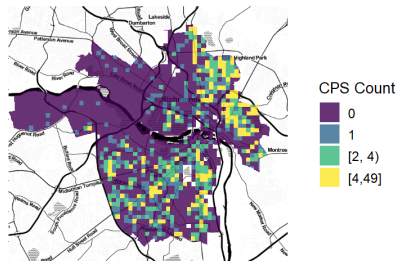
Additional data cleaning steps include the removal of events that are spatial and temporal duplicates and of maltreatment events that are labeled ‘unverified’.

In creating the dependent variable, a lattice grid, the ‘fishnet,’ is overlaid across Richmond, and maltreatment events are summed for each grid cell. The fishnet consists of 1,910 individual cells with an area of 1000 ft², which allows for a greater level of predictive resolution relative to, say, census tracts. For each grid cell, we also calculate the population normalized rate of maltreatment events per 100 residents by overlaying the fishnet grid onto 2010 census tracts and attributing to each cell a weighted population proportional to the area of the tract that falls into that grid cell.

Fishnet - Richmond, VA



CPS Count per Fishnet Cell



CPS Rate per 100 People

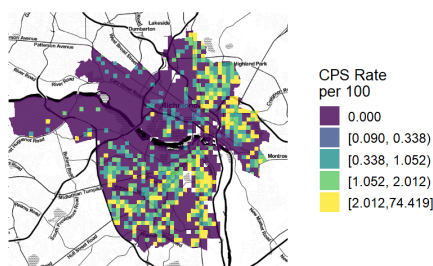


Figure 1

We also relate measures of exposure to the fishnet, aggregating risk and protective factors using three different strategies:⁹

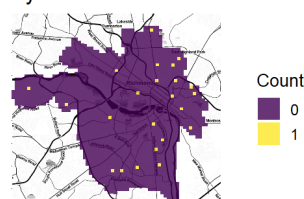
1. Net or sum of exposure events per grid cell.
2. The Euclidean distance from the center of each grid cell to the nearest exposure event.
3. The average Euclidean distance from the center of each grid cell to the five nearest event neighbors.

More than 200 features are created in this fashion, are scaled, and then are combined into a dataset that is then used in the modeling process.¹⁰ We also generate a series of spatial lag features, using the three feature-engineering approaches above to account for the spatial externalities associated with maltreatment. Figure 2 visualizes examples of each feature-engineering approach.

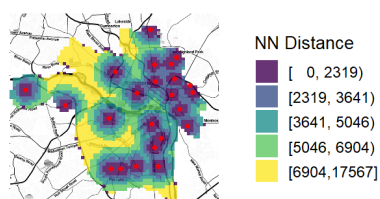
Community Center Locations



Community Center Count by Fishnet



Community Center Euclidean Distance



Community Center Average Nearest Neighbor Distance

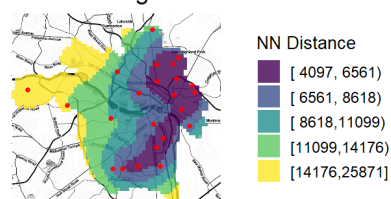


Figure 2

Exploratory Data Analysis

Exploratory Data Analysis (EDA) is a principled exploration of the data that allows natural patterns, structures, and relationships in the data to surface.¹¹ The tables and visuals created during this stage highlight outliers and anomalies, test assumptions, and uncover underlying structures. Moreover, a desirable outcome of EDA is to present the data in such a way that stakeholders ask new and interesting questions not previously thought of. This approach benefits from clearer goal setting and an atmosphere of collaboration between policy makers, technical specialists, and analysts.

In a process made even more prescient due to the complicating dimensions of space and time, EDA is employed here to gain a deeper understanding at the intersection of the contributing features, maltreatment outcomes, and subject matter expertise.

The EDA Methods Used Here Comprise the Following Steps:

- Calculating summary statistics for each of the features
- Plotting histograms and counts of categorical variables
- Mapping the distribution and density of each feature
- Visualizing the correlation between each variable
- Computing Global and Local Moran's I statistics
- Testing whether a given feature is statistically 'close' to maltreatment
- Estimating the distribution of the outcome variable

Summary statistics (e.g. minimum, maximum, deciles, counts, etc.) provide quantitative descriptions of each feature, and correlations inform the pairwise relationship between features and the outcome of interest.

Moran's I, a measure of spatial autocorrelation, is used here to estimate the pattern of spatial association for maltreatment counts. The values of Moran's I generally range between -1 and +1, but more extreme values are possible. A value of zero typically indicates spatial randomness, a value of -1 indicates negative spatial autocorrelation (i.e., a regular pattern), and a value of +1 indicates positive spatial autocorrelation (i.e., clustering). For this study, the Moran's I is calculated on both the global and the local scale, and global Moran's I results in a single value describing the universal autocorrelation. The `moran.mc` function of the `spdep` R package is used to derive the global I value through Monte Carlo simulation.¹²

The local Moran's I describes the spatial autocorrelation within a local neighborhood of eight fishnet grid cells surrounding a given fishnet grid cell. This neighborhood configuration is called the 'Queen case' because it is the same eight directions as the Queen moves in chess. The local measure of Moran's I also computes the p -value indicating the significance of the local autocorrelation. Both the Moran's I value and the p -value are plotted to visually denote significant positive and negative local clusters of maltreatment event counts.

A second simulation method is used to better understand whether risk and protective factors are more closely or distantly associated with maltreatment event locations.¹³ This is achieved by simulating a set of random points equal in quantity to the number of events for a specific feature and averaging the nearest neighbor distance to n maltreatment events. This is repeated 1,000 times, resulting in a distribution of randomly permuted nearest neighbor distances. Finally, this distribution is compared to the observed global average nearest neighbor distance of each contributing feature. If the observed distance of a given feature is closer than 95% percent of the randomly permuted distances (a p -value of 0.05), the feature is then considered to be 'close' to maltreatment citywide.

The final step in the EDA is to gain a better understanding of the statistical distribution of maltreatment event counts. Inherently, the number of maltreatment events per fishnet cell is a count data type, which is typically modeled by either the Poisson or Negative Binomial distributions.

The intuition for the Poisson distribution is that maltreatment is a relatively rare event and that the probability of this occurrence is independent after accounting for contributing factors. Further, it is assumed that the variance in maltreatment event counts is approximately equal to the mean of counts. This assumption limits the potential for drastic outliers in maltreatment event counts relative to the mean of all counts. In contrast, the Negative Binomial distribution can be conceptualized in a similar manner except that the variance is not the same as the mean in this distribution.

The `fitdistr` function in the `fitdistrplus` package is employed to simulate samples from the empirical maltreatment event count distribution and compare the goodness of fit to both the Poisson and Negative Binomial distributions.¹⁴ The results of this test are displayed graphically and used to choose between the two distributions.

Local Moran's I

Within the study framework, a variety of EDA approaches are employed to measure spatial dependence. Moran's I is a measure of spatial autocorrelation and is used here to estimate spatial association for maltreatment counts (Bivand and Piras, 2015). The local Moran's I describes the spatial autocorrelation within a local neighborhood of eight fishnet grid cells surrounding a given fishnet grid cell. The local measure of Moran's I also includes the p -value, indicating the significance of the local autocorrelation. Figure 3 illustrates the locations of statistically significant maltreatment clusters in the city of Richmond.

Statically significant maltreatment clusters

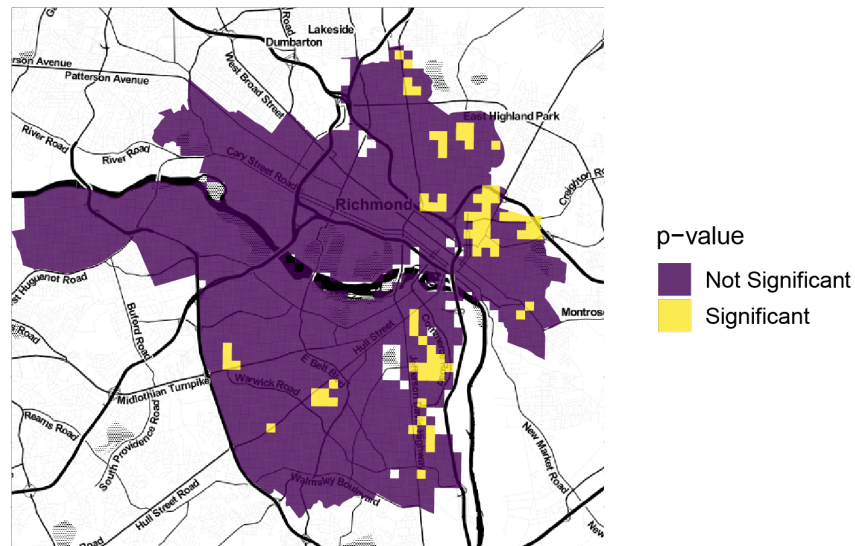


Figure 3

Testing whether features are statistically ‘close’ to maltreatment events

Next, we develop a statistical test to better understand if risk and protective factors are more closely or distantly associated with maltreatment event locations (Smith, 2018) by simulating a set of random points equal in quantity to the number of events for a specific feature and averaging the nearest neighbor distance to n maltreatment events. This is repeated 1,000 times, resulting in a distribution of randomly permuted nearest neighbor distances that is then compared to the observed average distance. If the observed distance for a given feature is closer than, say, 95% percent of the randomly permuted distances (a p -value of 0.05), we can conclude that the feature is indeed close to maltreatment citywide.

Pairwise correlations

In the Feature Engineering phase, we create more than 200 features. Figure 4 and Figure 5 display pairwise correlations for the top 15 most correlative risk and protective factors, respectively. Note the correlation coefficients associated with maltreatment count (‘cps_net’) and maltreatment rate (‘cps_rate’). The colors of the plot vary with the strength of the correlations, either positive or negative.

Three different prefixes are associated with each type of feature. NN refers to features calculated by taking the average distance between a fishnet grid cell and its n nearest risk/protective factor neighbor. Additionally, *ed* refers to the Euclidean distance between a fishnet grid cell and its one nearest risk/protective factor neighbor, and *agg* refers to the count of risk/protective factor events in a given fishnet grid cell.

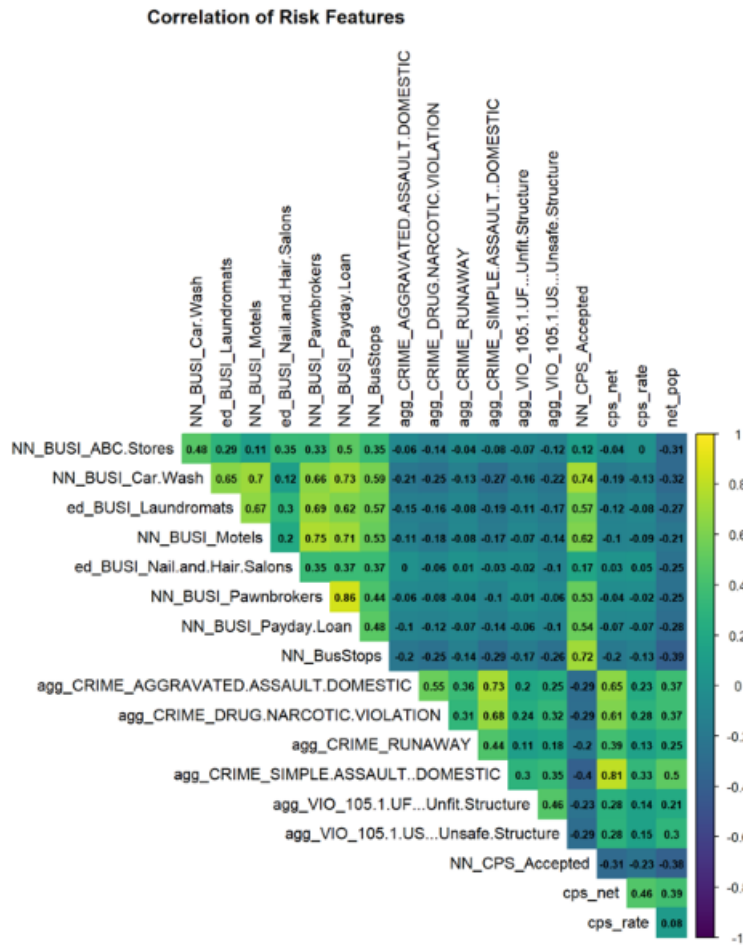


Figure 4

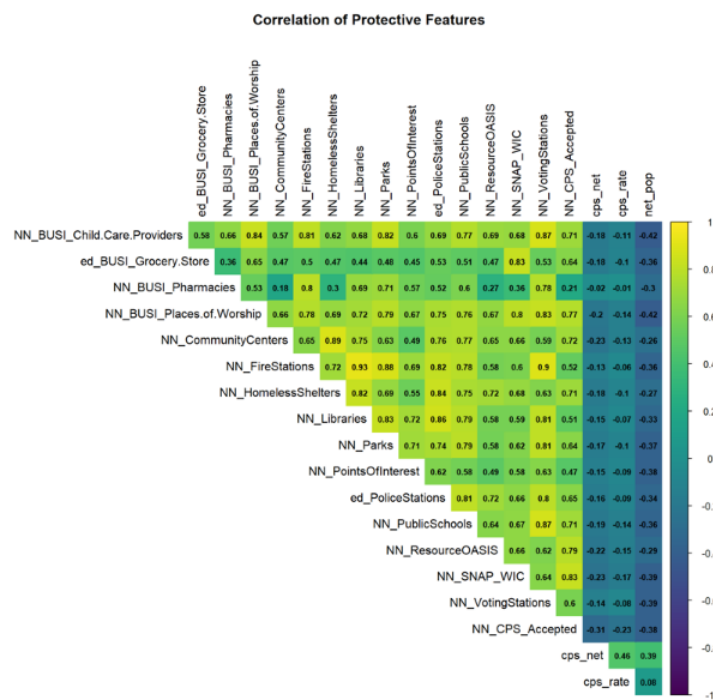


Figure 5

Model Fitting & Validation

In the context of this study, model ‘fitting’ describes the process by which a statistical algorithm learns about maltreatment risk by relating the interaction of risk/protective factors to maltreatment events across space. Once a model is fitted and validated, the learned pattern is applied back to the contributing features in each fishnet cell to predict the count of maltreatment events across space. This prediction then highlights areas where maltreatment is present but unreported.

The first step in the model-building process is to select the 15 most statistically important risk and protective feature sets. We select across the different feature types (Euclidean distance, average nearest neighbor distance, and aggregate counts) based upon statistical correlation. These features make up the final feature sets, which are then subjected to our models.

Three different algorithms are fit to model different aspects of the spatial process and are then combined into a fourth ‘meta-model.’ The three individual models are a Poisson Generalized Linear Model (Poisson GLM), a Random Forest model, and a Spatial Error model. The final prediction of maltreatment events is produced from the meta-model which is created by applying the Random Forest algorithm to the predictions made by the sub-models. The use of three different model algorithms represents an effort to understand different aspects of the highly complex system that contributes to the observation of a maltreatment event.

At each stage in this process, models are fit using a ‘leave one group out cross validation’ routine (LOGOCV). LOGOCV splits the data into spatially explicit groups, in this case neighborhoods, fits the models to all but one of the groups, and predicts maltreatment event counts for the excluded group. This process, explained in

greater detail below, tests how well the models generalize across neighborhoods. Below we explain the three sub-models and their inclusion in the final meta-model as well.

LOGOCV Neighborhoods

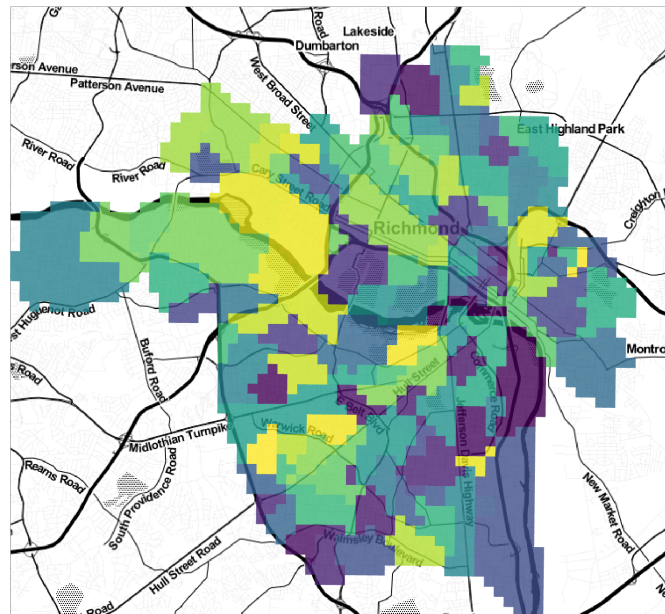


Figure 6

Poisson GLM

The Poisson GLM model, fit with the base R `glm` function, is an adaptation of linear regression that accounts for the characteristics of count data. The adaptations include modeling the residuals as Poisson distributed and transforming the linear model with a natural log function. Consequently, the predictions from a Poisson model are positive and represent mean expected counts conditional on the contributing risk or protective features present in each fishnet grid cell. In the meta-model, Poisson GLM predictions represent a linear model of a Poisson-distributed count process.

Random Forest

In this study, the Random Forest algorithm is fit using the `ranger` library.¹⁵ The Random Forest algorithm builds a series of decision tree models to learn the relationship between maltreatment and exposure variables. The stochastic approach to sampling from observed data ensures that each individual tree differs from the next. The Random Forest provides a ‘wisdom of many’ approach, contributing the nonlinear interactions between maltreatment and the corresponding features to the final meta-model.

Spatial Durbin Model

To model spatial interrelationships - also referred to as ‘spatial autocorrelation’ - a Spatial Durbin Model (SDM) is fit using the `errorsarm` function of the `spdep` package in R.¹⁶ In the study context, both exogenous exposure factors and neighboring rates of maltreatment affect the rate at which maltreatment events occur. Further, this model assumes that there may be latent features that impact the model errors but are not accounted by the

exposure features. The key model input of spatial autocorrelation is a spatial weights matrix relating maltreatment in a given grid cell to its neighbors. Modeling the underlying spatial maltreatment process provides a powerful predictive story when input into the final meta-model. Important to note is that the SDM is not fit with the LOGOCV method due to the complications of subsetting a spatial weights matrix in a cross-validation setting.

Meta-Model

A meta-model that combines predictions from the three sub-models generates the final maltreatment count predictions. The process whereby the three models are combined is straightforward; the predicted counts from each sub-model are input features of a new model fit with the Random Forest algorithm. Often referred to as model ‘stacking,’ this technique seeks to average out the variance in the three separate models. To reduce the risk of overfitting, the stacked meta-model is fit and predicted using the same LOGOCV routine as employed for the sub-models.

Model Validation

Assessing the accuracy and spatial generalizability of model predictions is crucial when considering how to embed this model in the provision of child welfare services. A variety of approaches are used for model validation, including leave one group out cross validation (LOGOCV) and assorted goodness of fit metrics. Some of these metrics are statistical in nature, while others measure goodness of fit across space.

Leave One Group Out Cross Validation

LOGOCV is a technique for ensuring that model predictions are generalizable across neighborhoods. The first step in LOGOCV is to assign each fishnet cell to the neighborhood that encompasses it. The model-fitting process utilizes this information to learn from the maltreatment experience in one neighborhood and then project what it has learned from that experience to a different group of neighborhoods. From a policy perspective, LOGOCV seeks to evaluate whether this experience is relevant to varying neighborhood contexts in Richmond and, from a modeling perspective, helps to ensure that our models are not overfit. Each of the 148 neighborhoods takes a turn as the hold out, thus totaling in 297 individual sub-models and 297 separate estimates of goodness of fit.¹⁷

Goodness of Fit Metrics

Model error is defined simply as the difference between each grid cell’s observed count of maltreatment events and its predicted count. Complicating matters is that 297 models yields more than 567,000 grid cell level predictions, and so we calculate several statistics to summarize and aggregate these errors in order to evaluate and compare models. We describe each below:

The Mean Absolute Error, or MAE, measures the average absolute difference between observed and predicted values.¹⁸ An example interpretation of MAE is that, ‘on average, the model is off by plus or minus 1.67 events.’ MAE is easy to interpret in a policy context but has some drawbacks, namely, that the direction of the error is unknown and that every error is awarded the same severity. Thus, the MAE assumes that an error produced by a predicted count of 5 and an observed count of 7 events is comparable to a prediction of 23 and an observed value of 25 events. However, we employ metric due to its obvious interpretation and common usage in the assessment of predictive models.

The second goodness-of-fit metric used in this study is called the Logarithmic Score. Although not as straightforward as the MAE, it has qualities that make it well-suited to count-based predictions. The intuition of the logarithmic score is as follows: What is the likelihood of the observed count given the predicted count. For instance, if the model predicts 10 events and the observed count is seven events, then what is the probability of observing those seven events given that the prediction of 10 is indeed the correct number? Thus, the

logarithmic score measures the deviance between the predicted and observed counts by calculating the probability density of the observed value from a Poisson distribution centered on the predicted value. The goodness-of-fit measures below report the negative log of the probability density so that the value should always be minimized. In the results portion of this report, this logarithmic score is converted back to a probability and aggregated, resulting in the average likelihood that the observed counts are true given the predicted maltreatment counts. Values closer to one indicate a higher relative likelihood, those around 0.5 indicate maximum uncertainty, and values near zero signify a small likelihood.¹⁹

Accuracy and Generalization Tradeoff

The purpose of the LOGOCV and of the goodness-of-fit metrics is to assess model errors on average and across space. A model that perfectly predicts observed event counts for each fishnet grid cell would be very accurate but would not generalize well to other cells because the underlying contributing features vary across the city. Conversely, a model that predicts the same count of maltreatment events for every cell would generalize well but would not be relevant to conditions within any one cell. Thus, LOGOCV and the associated metrics help establish a balance between model accuracy and model generalization. Given this study’s purpose, it is important to create a model that is accurate enough to instill confidence but general enough to be applicable in areas where few maltreatment cases have been documented.

Results

According to the results of the modeling and validation stage of this report, the three sub-models (Poisson GLM, Random Forest, and SDM) attain comparable levels of accuracy and generalizability, and the meta-model successfully captures the nuances of each. Although the models are accurate, there is a significant amount of variation in accuracy between neighborhoods. As we describe below, the meta-model generalizes well across neighborhoods exhibiting varying poverty rates but does not perform as well across neighborhoods characterized by variations in race.

Below we provide both spatial and aspatial goodness-of-fit metrics.

Average goodness of fit results

The results describe a trade-off between model accuracy and an ability to generalize well across different neighborhoods. Table 20 - Model results provides goodness-of-fit results. The LOGOCV process allows each neighborhood a turn to be withheld as a validation set. In the following table, means therefore describe relative goodness of fit across all hold-out neighborhoods, and standard deviations measure the variation in goodness of fit across each held out neighborhood. The inability to distribute a spatial weights matrix across cross-validation folds makes it infeasible to report standard deviations for the Spatial Durbin model.

As can be seen, the meta-model is the strongest of the four models. The mean and standard deviation in Mean Absolute Error (MAE) for the meta-model are about half of one maltreatment event and three quarters of one maltreatment event, respectively.

Table 20 - Model results

Model Name	R2 mean	R2 sd	MAE mean	MAE sd	RMSE mean	RMSE sd	Logdev mean	Logdev sd
GLM - Poisson	0.522	0.401	0.56	0.767	0.927	1.336	0.685	0.24
Meta-Model	0.513	0.393	0.533	0.746	0.9	1.308	0.697	0.227

Model Name	R2 mean	R2 sd	MAE mean	MAE sd	RMSE mean	RMSE sd	Logdev mean	Logdev sd
Random Forest	0.496	0.398	0.547	0.739	0.888	1.347	0.666	0.226
Spatial Durbin (sqrt)	0.835	NaN	0.486	NaN	1.278	NaN	0.706	NaN

R2, or R Squared, is a traditional measure of goodness of fit. Although typically not used to evaluate count outcomes, we include it here because it will be familiar to many readers.

MAE or Mean Absolute Error is the absolute difference between the observed and predicted maltreatment counts. The meta-model MAE equates to roughly one half of one maltreatment event on average, thus suggesting that the model is accurate. The relatively high standard deviation of the MAE suggests that greater errors can be found in certain places, namely those displaying very high maltreatment counts.

RMSE , or Root Mean Squared Error, is the standard deviation of the prediction error. Like MAE, RMSE is reported on the scale of the dependent variable, but it varies due to being heavily weighted by errors of high magnitude.

For the logarithmic score (logdev), the mean is 0.697 with a standard deviation of 0.227. This equates to a 95% confidence interval between 0.66 and 0.733 for the population average. Intuitively, this result indicates that, on average, the probability that the model estimates are correct given the documented maltreatment counts is between 0.66 and 0.733. While the population average of errors from independent LOGOCV estimates is helpful for assessing model generalizability, knowing these errors’ distribution, both statistically and spatially, is equally important.

Of note in the above Table 20 is the reduction not only in MAE and logdev but, perhaps more importantly, in the standard deviation in those metrics across all 149 neighborhoods. The meta-model results in an average MAE of 0.533, a standard deviation of 0.746, and a 95% confidence interval across the entire population of neighborhoods falling between 0.412 and 0.653. Since the MAE scale is absolute count of maltreatment events, the population average MAE is therefore less than one incident.

Figure 7 shows the meta-model’s predicted vs. observed maltreatment event counts. The black line represents a perfect fit whereas the blue line represents the predicted fit of the meta-model. This plot provides visual evidence of a strong model. Nevertheless, as the plot also shows, model errors are much higher where observed counts are highest. In other words, the model fits most of the data well but tends to break down in grid cells with relatively greater counts, and, as we discuss below, this has some ramifications with respect to model generalizability.

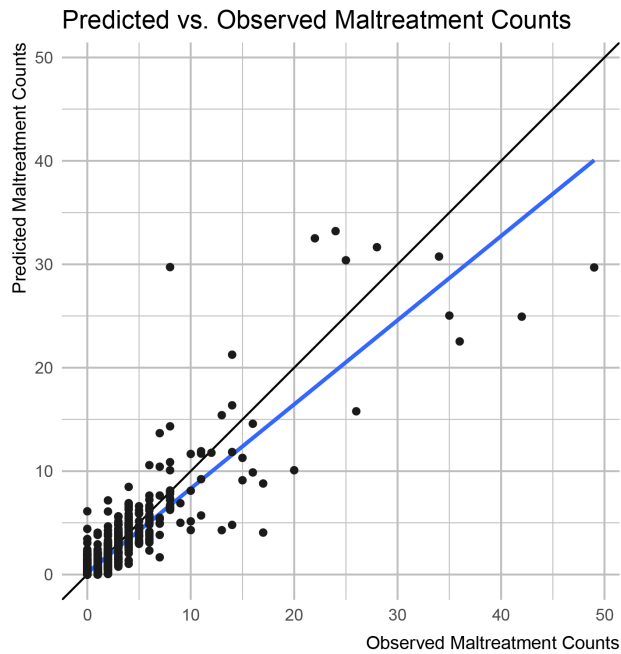


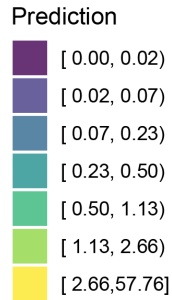
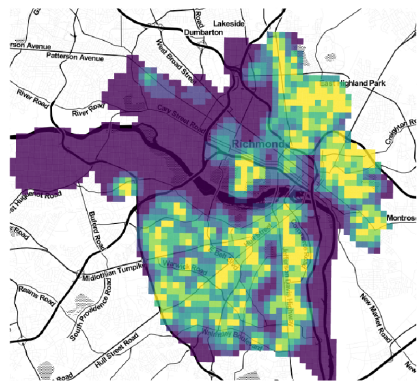
Figure 7

Mapping goodness of fit

From the spatial perspective, Figure 8 below illustrates the MAE and the predicted maltreatment count for each of the three sub-models and the meta-model. As the plots show, each model’s approach to prediction is unlike its peers. The Poisson linear model primary focus is the main areas of recorded maltreatment, and it generates a relatively lower variance for areas outside of the City of Richmond’s primary population centers. The Random Forest model assigns relatively higher variances across areas where few incidents are documented, but where underlying risk and protective features are present. The SDM model incorporates knowledge of the underlying spatial organization of both maltreatment events and risk/protective factors. Given that this model is fit and estimated on the full Richmond dataset, that information translates into ‘patchiness’ of estimates. Finally, the meta-model’s prediction pattern moderates the tendencies of the three sub-models and identifies known areas of higher maltreatment rates. Note that the meta-model also predicts areas as having high risk where the risk/protective factors are present but recorded events are few.

Poisson Regression

Predicted Maltreatment Count



MAE

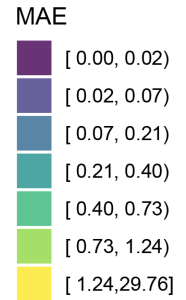
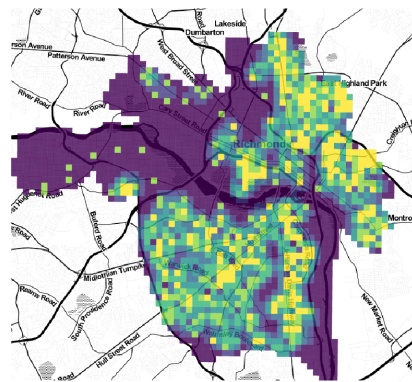
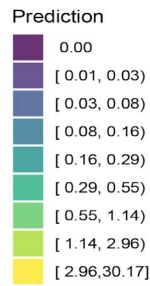
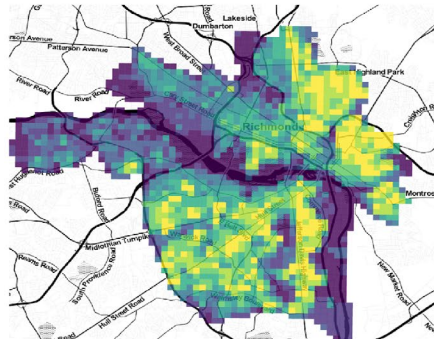


Figure 8

Random Forest

Predicted Maltreatment Count



MAE

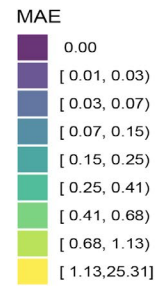
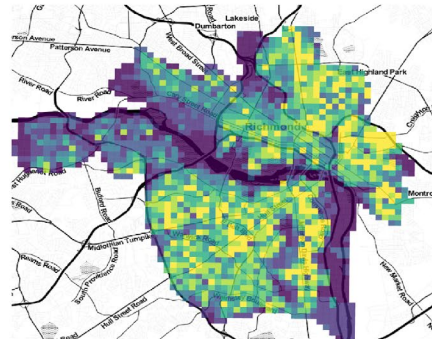
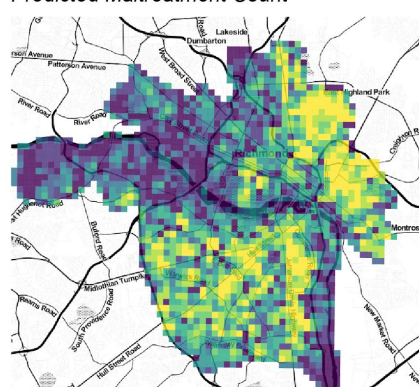


Figure 9

Spatial Durbin Model

Predicted Maltreatment Count



MAE

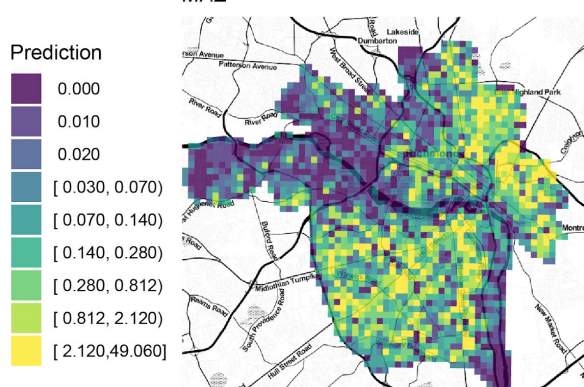
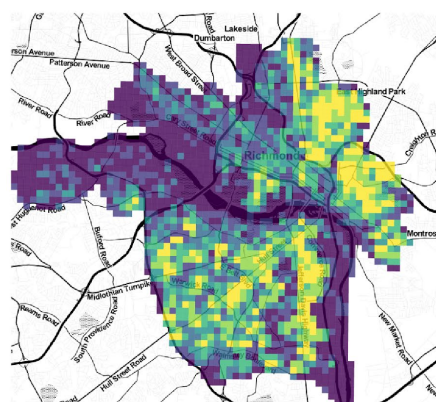


Figure 10

Meta-Model

Predicted Maltreatment Count



MAE

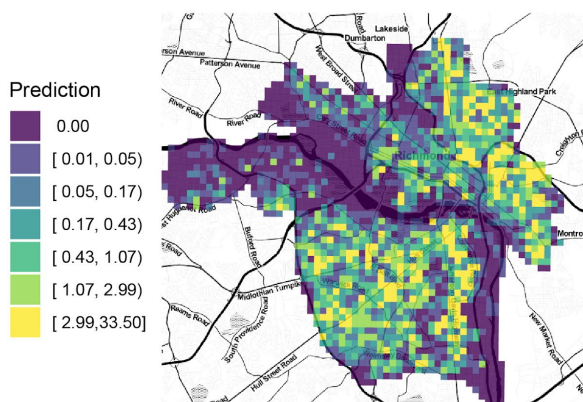


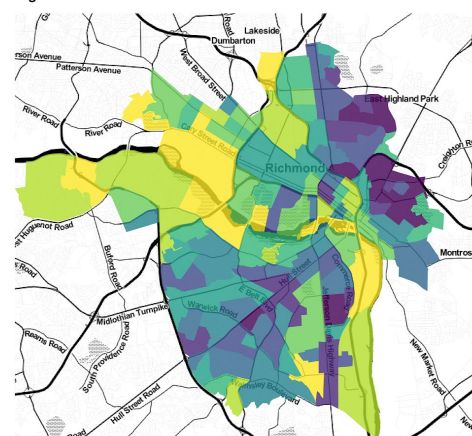
Figure 11

Further complementing these findings, Figure 11 shows the goodness-of-fit metrics broadened to neighborhood level for meta-model estimates. These goodness-of-fit indicators were created by way of LOGOCV. Generally speaking, the MAE and logarithmic score metrics follow a similar pattern, with higher errors produced for neighborhoods with higher rates of maltreatment events.

If the model were perfectly generalizable, model errors by neighborhood would be randomly distributed. The map in Figure 11 shows that MAE clusters slightly, particularly in neighborhoods in the northeast of the city. A Global Moran's I test confirms the clustering of errors, with a p-value of 0.001.

Out-of-Fold error by neighborhood

Logarithmic score



MAE

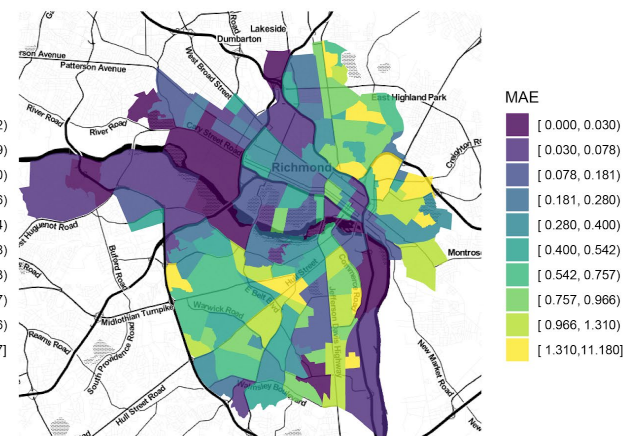


Figure 12

Neighborhood Typology Comparison

Income and race are inextricably linked to many of the census and exposure features incorporated in the models, but no variables explicitly measuring race or income are included in any of the models. While feature importance provides some glimpses into how the model predicts, the best way to understand the inner-workings of a model is to look for patterns in how it predicts. Our approach for doing so tests how well the model generalizes across both rich and poor neighborhoods and across predominantly white and minority neighborhoods.

Two census attributes are selected for these purposes, including percent living below poverty and percent non-white. These census data are joined to [Neighborhood Statistical Areas](#) (NSA) to create high and low neighborhood typologies.

Next, median meta-model predictions are calculated for each NSA, and goodness of fit is compared between high and low areas. Tables 21 and 22 below list the median logarithmic score for both the high and low classes for each of the census variables. If the model generalized well to both neighborhood typologies, the logarithmic score should be comparable across high and low categories. We find this to be true for poverty-related differences across the city but less so for race-related differences.

Table 21

Poverty	Log_score	Count_events
Low	0.658	668
High	0.635	1145

Table 22

Non_White	Log_score	Count_events
Low	0.757	524
High	0.471	1289

Feature Importance

Next, we look under the hood of the model by, first, exploring feature importance in the plot below, which shows the features of the random forest sub-model that make the greatest contribution in predicting maltreatment. However, we caution the reader to consider these relationships to be the result of correlation and not of causation. The most important predictor, NN_CPS_Accepted, is the spatial lag variable, which accounts for the spatial externalities associated with maltreatment. Four of the top ten features relate to the domestic occurrence of crime, including assault and juvenile runaway, whereas three of the top ten are control variables describing demographic and housing unit characteristics. Other significant exposure factors are present, including vacant housing and the presence of community centers and motels.

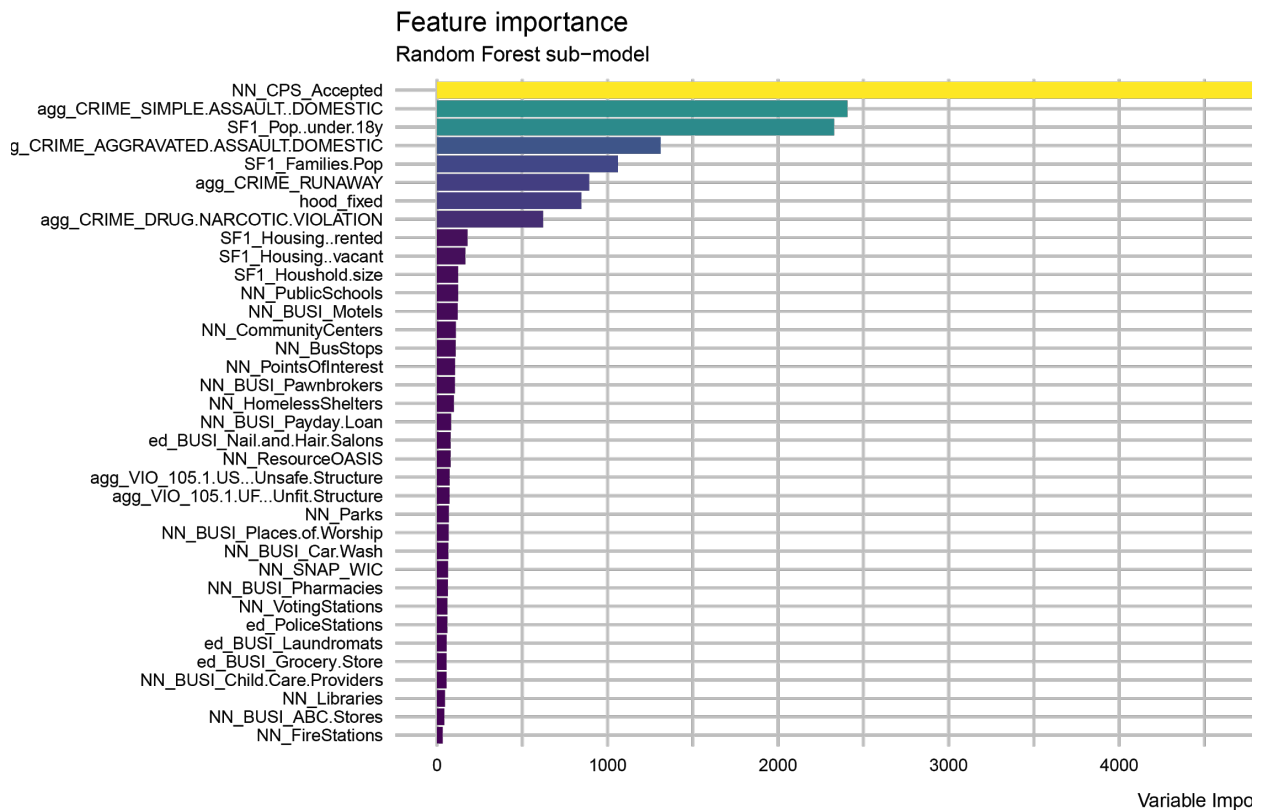


Figure 13

Comparing meta-model predictions to kernel density

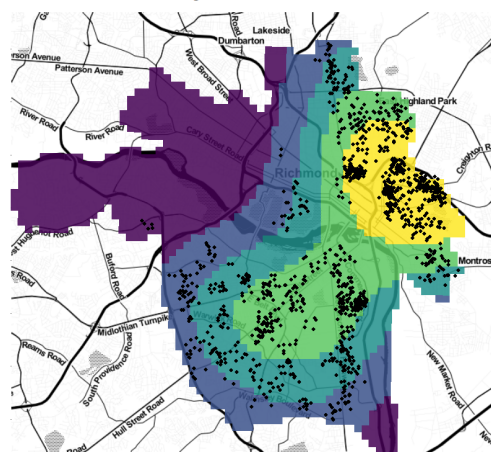
Perhaps the strongest method for assessing the usefulness of a predictive model is to compare its predictive power to that of the currently used resource allocation strategy. Although no equivalent decision-making tool exists in Richmond, we can compare our model to another common spatial targeting algorithm - Kernel Density Estimation (KDE).

KDE is a simple spatial interpolation technique that calculates ‘predicted risk’ by calculating a weighted local density of maltreatment events. No risk/protective factors are incorporated into the model, and no measures of statistical significance can be calculated. To compare meta-model predictions and with those generated by KDE, predictions from both are divided into five risk categories. We then overlay held-out maltreatment events that were not used to fit the original model, and calculate the percent of observed maltreatment events that fall into each predicted risk category.

Figure 14 maps the comparison. For privacy purposes, some cartographic information is redacted. The KDE clearly picks up the main areas of recorded events, but also interpolates high predictions for maltreatment in the areas between and beyond. The meta-model is far more targeted.

Risk categories from KDE

Privacy Controls: Maltreatment events in grid cells with 1 point are masked; Remaining event locations are offset at random.



Risk categories from meta-model

Privacy Controls: Maltreatment events in grid cells with 1 point are masked; Remaining event locations are offset at random.

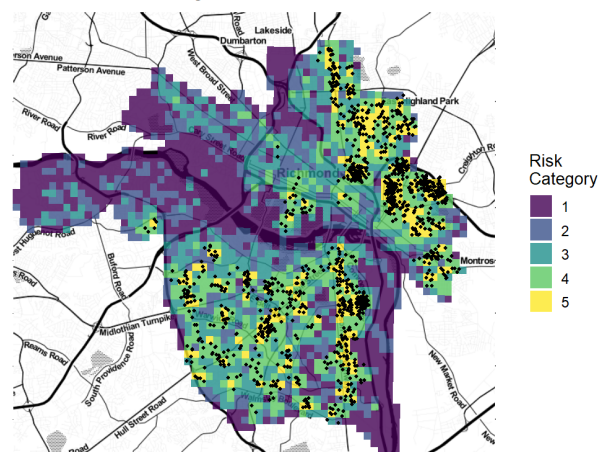


Figure 14

Figure 15 quantifies the comparison in chart form. The highest risk category for the meta-model captures approximately 70% of recorded maltreatment events, whereas the KDE captures only about 35%. The spatial risk model therefore vastly outperforms KDE.

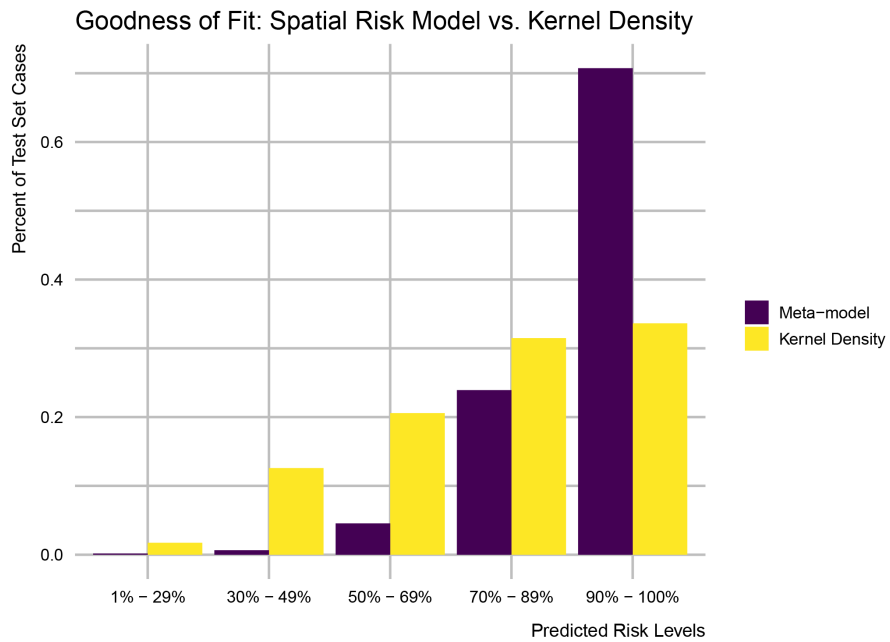


Figure 15

Fishnet grid cell

Figure 16 shows the weighted poverty rate by fishnet grid cell to explore the correlation between poverty rate and risk.

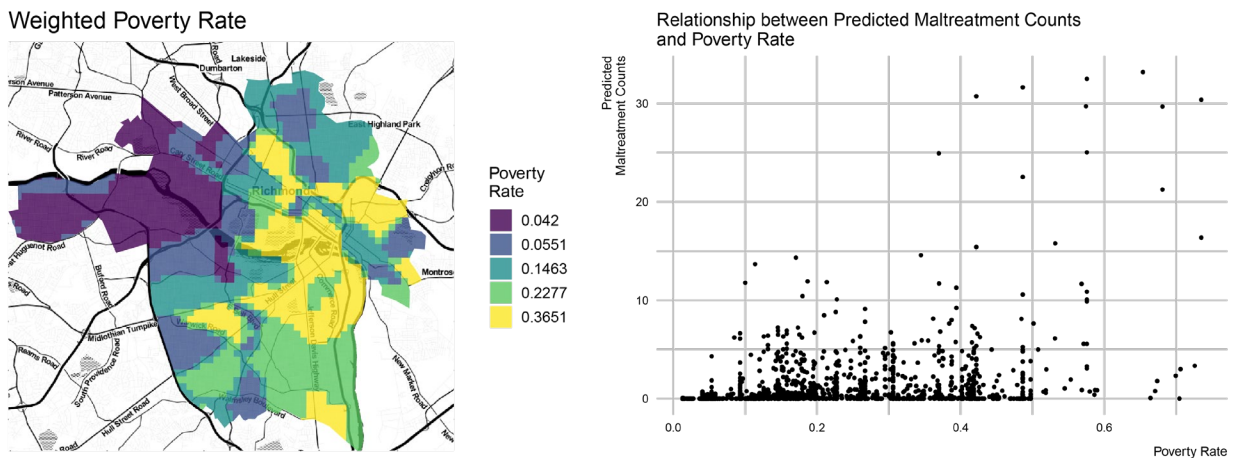


Figure 16

The correlation between poverty and predictive risk is marginal at 0.29, even when all the zeros are removed.

Methodology Details

Accuracy and Generalizability Tradeoff

The tradeoff between accuracy and generalizability lies at the heart of the analysis. A model that is perfectly accurate will not reveal areas where children may be at risk despite a lack of reported maltreatment, and a model that is perfectly generalizable may fail to provide targeted intelligence to identify areas at serious risk for maltreatment.

Definitions and Alternate Terminology

Accuracy is defined as the model’s ability to minimize the difference between the observed and predicted counts of maltreatment events. These differences are referred to as ‘errors,’ and significant attention is paid to their nuances in the methodology and model validation. Generalizability refers to the model’s ability to make comparable predictions across neighborhoods regardless of differences in factors like income and race.

Validation of the Theoretical Framework

Geospatial risk models such as the one presented here are based on the concept that maltreatment events occur in areas where there is an accumulation of ACEs and related outcomes among the exposed population. As exposure increases, so should the severity of related outcomes, including child maltreatment.

Maltreatment Risk and Removals of a Child from the Household

Have removals occurred in places the model predicts to be high risk? To answer this question, the next figure presents counts of the number of removal events by risk category. An overwhelming proportion of removals occur in the highest risk category.

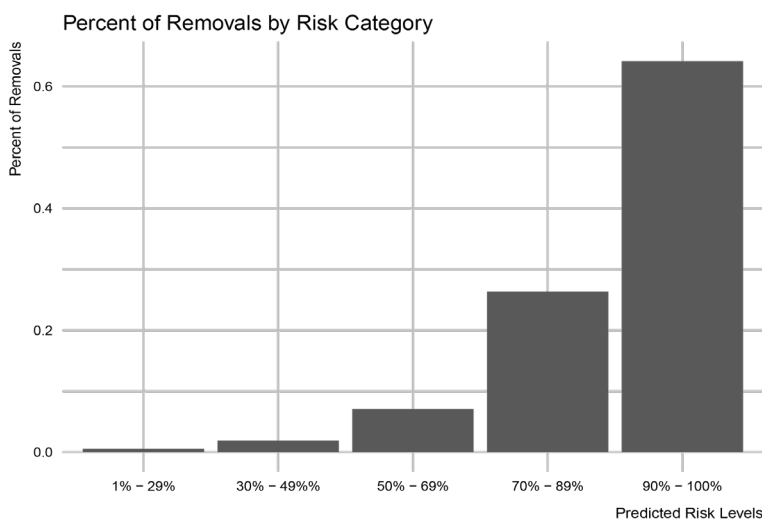


Figure 17

Maltreatment Risk and Child Fatalities

Figure 19 maps locations of child fatalities over the predicted maltreatment risk categories, and, as the associated bar plot shows, the majority of child fatalities have occurred in the two highest risk categories.

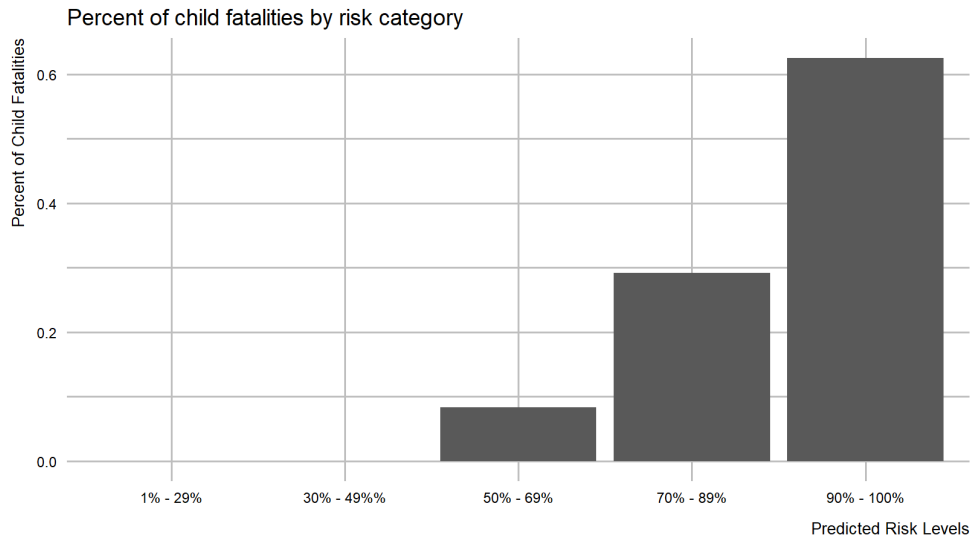


Figure 18

The risk for injury-related deaths, infant deaths, and fatal disease outcomes associated with ACEs should also cluster in the highest risk areas. Unfortunately, these types of death data were not available at the time this report was written.

ALIGN

PROGRAM PHASE SUMMARY



P R E D I C T
A L I G N
P R E V E N T

ALIGN

Program Phase Summary

Background:

As demonstrated in the PREDICT phase, more than two thirds of future child maltreatment cases will occur in about 10% of a city's geographic area. Due to a relatively high concentration of adverse childhood experiences (ACEs) exposure in those areas, problems associated with ACEs exposure will also be higher in those areas. ACEs exposure is associated with such long-term outcomes as shorter life expectancy, chronic disease and disability, obesity, smoking, alcohol and drug abuse, risk of intimate partner and sexual violence, depression and anxiety, suicidality, sexually transmitted infections, unintended and teenage pregnancies, low birth weight and fetal death, psychological disorders, and risk of aggressive and/or criminal behavior, among others. Many of these long-term outcomes also constitute risk factors for child maltreatment. What we learned from the PREDICT phase is that the same small population at risk for child maltreatment also experiences ACEs related outcomes due to shared risk factors. This relationship can be most easily understood by mapping ACEs related death data so that the spatial co-occurrence with child maltreatment can be visualized.

Communities typically have programs and services devoted to the prevention of each ACEs related problem individually. However, each prevention initiative or program is often chronically underfunded and may have difficulty with community engagement.

The purpose of the ALIGN phase is to make the most of existing prevention resources, programs, and supports by leveraging cross-sector resources to make a greater prevention impact in those places where the most vulnerable population is located. Combining efforts where there is topical overlap makes it theoretically possible to improve the effectiveness of multiple initiatives simultaneously, while also reducing the need for vulnerable community members to participate.

ALIGN PHASE

- Change readiness assessment management plan/materials creation
- Community prevention services and asset mapping
- Market segmentation - psychographics for prevention messaging
- Capacity needs and gaps analysis for prevention resources
- Identification of community champions for prevention initiatives
- Presentation/engagement material development for stakeholder strategic planning to explain predictive analytics and foster collaboration to develop shared goals for prevention

These will be discussed in detail below.

Capacity and Gap Analysis Table

At the time this report was written, there was insufficient Richmond-specific data on services currently provided to complete this analysis.

Readiness Assessment

Change management supports the collective impact of the PAP program, beginning with a change readiness assessment whose purpose is to determine the level of readiness needed for change to happen successfully. Specifically, it analyzes the level of preparedness of the conditions, attitudes, and resources, at all levels in an organization, or the combination of related elements that are the focus of a community alignment initiative.

From the National Implementation Research Network, NIRN, perspective, the change assessment described above answers the following questions:

Needs	How well does the program or practice appear to meet identified needs?
Fit	How well does the program fit with current initiatives, priorities, structures, supports, and community values?
Resource Availability	What are the funding requirements? Is funding available to implement and sustain the program or practice as intended?
Evidence	What evidence indicates that the outcomes expected if the program or practices are implemented well will actually occur?
Capacity to Implement	Can the program be implemented as intended and then sustained, and implementation improved over time?

Based on the complexity of the proposed change, it is important to truly understand readiness as a precursor to potential intervention (i.e., improving one or more of the five categories listed above) and eventual implementation of the program (the change).

The feedback and resulting changes from a readiness assessment, in turn, support the following five elements needed to maximize collective impact:

Common Agenda	The shared vision, with a common understanding of the problem and a joint approach to solving it through agreed-upon actions
Shared Measurement	Data collection and results measurement are consistently handled throughout the change, ensuring that participants remain aligned and mutually accountable
Mutually Reinforcing Activities	Activities may be differentiated but are coordinated through a common action plan
Continuous Communication	is maintained across all participants to achieve mutual trust, objective achievement, and motivation

Backbone Support

Activities are coordinated through a central organization or champion

**ALIGN PROGRAM
 WORKSHEETS**

Change Readiness Survey

The Need for Change

- This organization needs to change
- The vision of the change is clear and understood
- I understand why the change is necessary
- The change is needed for clear, rational reasons
- The scope of the change is achievable and reasonable

<input type="checkbox"/>	Strongly Disagree	<input type="checkbox"/>	Disagree	<input checked="" type="checkbox"/>	Neutral	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly Agree	<input type="checkbox"/>	N/A
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Leadership and Management

- Senior leadership is committed to the change
- There is clear change leadership by the managers
- Managers will support staff during the change
- I can discuss the change with my manager

<input type="checkbox"/>	Strongly Disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neutral	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly Agree	<input type="checkbox"/>	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Attitude to Change

- The change will be beneficial for me
- The change will be beneficial for the organization

<input type="checkbox"/>	Strongly Disagree	<input type="checkbox"/>	Disagree	<input checked="" type="checkbox"/>	Neutral	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly Agree	<input type="checkbox"/>	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Communications

- The information provided about the change has been useful
- The information provided about the change has been timely
- I can provide feedback for the change easily
- I think the staff is being consulted enough regarding the change

<input type="checkbox"/>	Strongly Disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neutral	<input type="checkbox"/>	Agree	<input checked="" type="checkbox"/>	Strongly Agree	<input type="checkbox"/>	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 19



**ALIGN PROGRAM
 WORKSHEETS**



Change Readiness Survey

Change Preparation

I have the needed knowledge and skills to support the change
 Change is usually well planned in this organization
 The organization provides training for those who need it
 Our staff has the needs required for the change and can improve upon this base

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
I have the needed knowledge and skills to support the change	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Change is usually well planned in this organization	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The organization provides training for those who need it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our staff has the needs required for the change and can improve upon this base	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 20

Protective Land Uses

The maltreatment predictions generated by the model suggest where education, outreach, and prevention efforts should be concentrated to reach the children most vulnerable to maltreatment. What protective assets are already available in these locations? We answer this question using some of the original protective-factors data gathered for the predictive model, and stakeholders can replicate this approach on a more finite list of sites that could host prevention interventions. The following figure shows the distribution of protective land uses by type within the City of Richmond.

Protective land uses

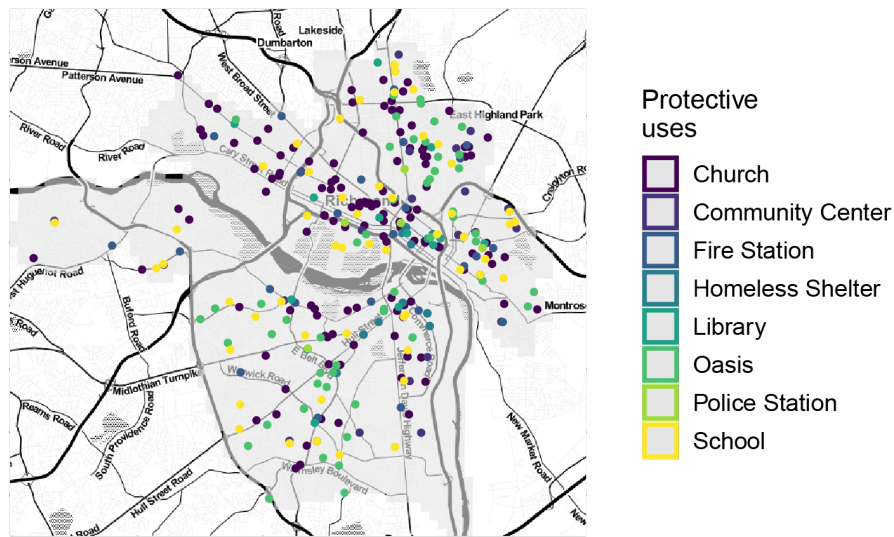


Figure 21

A relative measure of risk exposure is then calculated for each protective-factor land use by drawing quarter mile buffers around each site and taking the mean count of predicted events. The circles with a high predicted count of maltreatment events are yellow and green and represent protective assets that are optimally positioned to reach the population in highest risk areas. A quarter mile buffer was chosen because that distance is walkable, if the area is safe enough, for residents with transportation limitations to reach on foot.

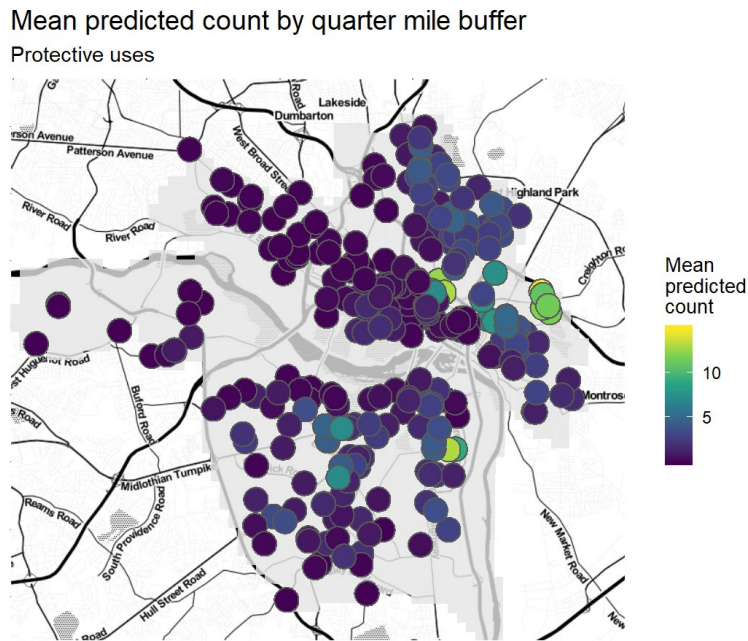


Figure 2.8

Figure 22

Potential Prevention Locations Inside Highest Sensitivity Class Areas

Listed below are the specific potential prevention assets that are best located to reach the most vulnerable children in Richmond City.

Table 23

Use	Name	Address	Mean Predicted Count
Church	Shalom Baptist Fellowship Church	None given	13
Church	Sixth Mount Zion Baptist Church	None given	13
Church	Ebenezer Baptist Church	None given	7
Community Center	Fairfield Court Community Center/RRHA	None given	15
Community Center	Creighton Court Community Center	None given	12
Community Center	Calhoun Community Center and Playground	None given	12
Fire Stations	Richmond Fire Station 5	None given	9

Use	Name	Address	Mean Predicted Count
Fire Stations	Richmond Fire Station 16	None given	6
Fire Stations	Ambulance Station 40	None given	3
Homeless Shelter	None given	180 E Belt Blvd, Richmond, VA, 23224	4
Homeless Shelter	None given	1201 Hull St, Richmond, VA, 23224	2
Homeless Shelter	None given	1201 Hull St, Richmond, VA, 23224	2
Library	North Avenue Branch Library	None given	5
Library	East End Branch Library	None given	4
Library	Hull Street Branch Library	None given	2
Police Station	First Precinct	None given	4
Police Station	Second Precinct	None given	4
Police Station	Third Precinct	None given	2
School	Woodville Elementary School	None given	12
School	Fairfield Court Elementary School	None given	11
School	Preschool Development Center	None given	11

Optimally Located Churches and Faith Organizations

As mentioned previously, this process can be repeated for a specific type of potentially protective site. Figure 24 displays the relative measure of risk exposure for churches and other faith organizations, and Table 24 lists the ten most optimally located churches based on the mean predicted count of maltreatment events that have occurred within a quarter mile of the church or faith community.

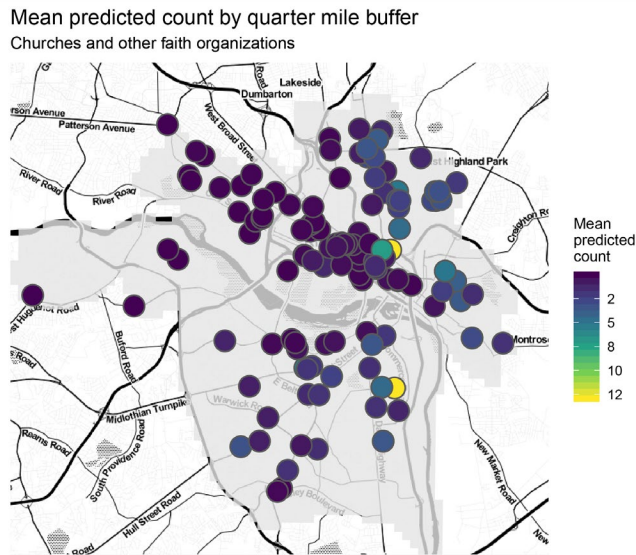


Figure 2.9

Figure 23

Table 24

Name	Address	Mean Predicted Count
Shalom Baptist Fellowship Church	None given	13
Sixth Mount Zion Baptist Church	None given	13
Ebenezer Baptist Church	None given	7
Swansboro Baptist Church	None given	6
New Canaan Baptist Church	None given	5
Bible Way Church	None given	5
Saint Philip's Protestant Episcopal Church	None given	5
Bethlehem Baptist Church	None given	5
Mount Olivet Baptist Church	None given	4
Saint John Baptist Church	None given	4

Optimally Located Licensed Child Care Providers

Figure 25 evaluates the relative risk exposure of licensed child care providers within Richmond, and Table 25 lists the top provider locations sorted by type and mean predicted count.

Table 25

Name	Address	Mean Predicted Count
Licensed Child Day Center	1004 St John St Richmond, VA, 23220	19
Licensed Child Day Center	1606 E 18th St Richmond , VA, 23224	12
Licensed Child Day Center	2012 Selden St Richmond , VA, 23223	11
Licensed Family Day Home	2700 Newbourne St Richmond, VA, 23223	13
Licensed Family Day Home	3416 Delaware Ave Richmond, VA, 23222	4
Licensed Family Day Home	3200 Utah Pl Richmond, VA, 23222	4
Recreational/Instructional Exempt Program	900 Mosby St, Richmond, VA, 23223	7
Recreational/Instructional Exempt Program	238 E 14th St Richmond, VA, 23224	3
Recreational/Instructional Exempt Program	4011 Moss Side Ave Richmond, VA, 23222	3
Religious Exempt Child Day Center	4212 Chamberlayne Ave Richmond, VA, 23227	5
Religious Exempt Child Day Center	3401 Chapel Dr Richmond, VA, 23224	4
Religious Exempt Child Day Center	1515 Chamberlayne Ave N Richmond , VA, 23222	4
Voluntarily Registered Day Home	1814 Fairfax Ave Richmond, VA, 23224	4
Voluntarily Registered Day Home	3322 Delaware Ave, Richmond, VA, 23222	3
Voluntarily Registered Day Home	703 N 33rd St, Richmond, VA, 23223	3

Finally, Figure 26 shows the relative measure of risk exposure for resource homes. Resource homes are locations certified to support children who are in foster care. Table 26 lists the top resource home locations.

Mean predicted count by quarter mile buffer
 Locations certified to accept foster care children



Figure 2.11

Figure 25

Table 26

Name	Resource type	Mean Predicted Count
Richmond City Jail	Detention/Correctional Facility	8
Richmond Detention Home	Detention/Correctional Facility	3
Medical College of Virginia (MCV)	Hospital (Medical)	1
Children’s Hospital of Richmond	Hospital (Medical)	1
Chippenham Hospital	Hospital (Medical)	1
Richmond City DSS ILP	IL/Supervised Program	0
Richmond City Independent Living Program	IL/Supervised Program	0
Gates to Success ILA	IL/Supervised Program	0
Individual	Individual	7
Individual	Individual	7
Individual	Individual	5
Elk Hill - Northside	Residential	4
Kids in Focus II	Residential	0

Do Home Visits Occur in High-Risk Places?

Our data indicates 44 home visit events occur in Richmond during the study period. For privacy reasons the map of risk predictions and home visits is redacted. Figure 28 aggregates these data and illustrates that the majority of home events occur in the highest risk category.

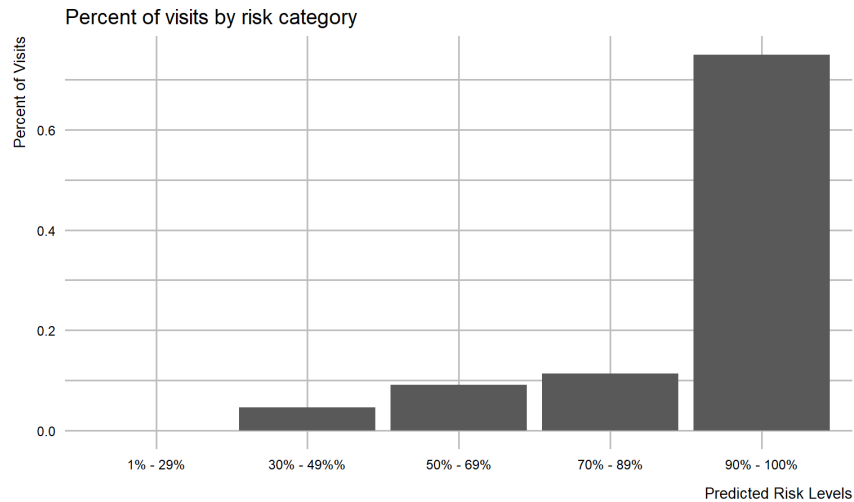


Figure 26

Maltreatment Risk and Protective Resource Prevention Centers

Protective resource prevention centers are an important family resource in Richmond. Are they located in optimal locations? To answer this question, we overlay center locations atop risk categories and calculate a relative exposure score for each in Figure 29.

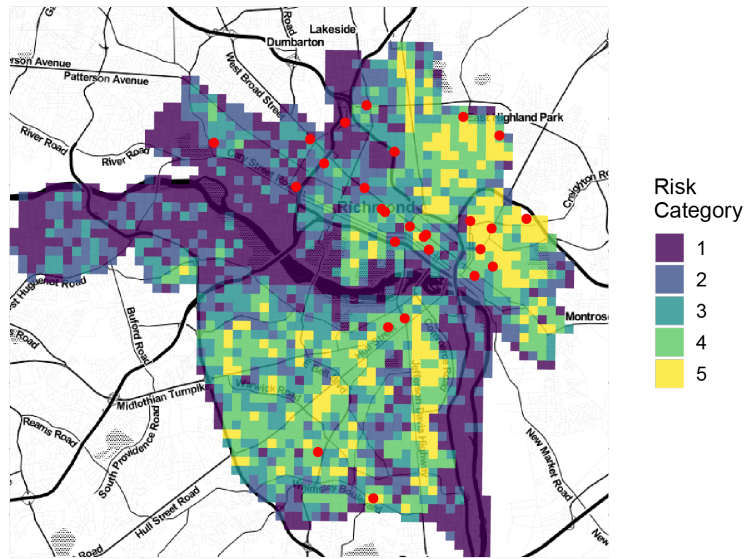


Figure 27

Figure 30 maps the mean predicted maltreatment count within a quarter mile of each protective resource center. The low count of maltreatment events within this radius suggests that some of these centers are not optimally located relative to maltreatment risk.



Figure 28

Optimally Located Event Spaces

Potential event spaces in the highest and second highest risk quintiles include the following:

Table 27

Name	Use
Cannon Creek Nature Area	Park
James River - North Bank Park (Texas Beach)	Park
Battery Park	Park
Crooked Branch Ravine Park	Park
Monument Avenue Linear Park	Park
Bellemeade Community Center	Community Center
Blackwell Community Center (Charlie D Sydnor Playground)	Community Center
Westover Community Center	Community Center
Thompson Community Center	Community Center
Pine Camp Arts and Community Center	Community Center
Reid Community Center and Playground	Community Center

Community Member Surveys / Needs

Instead of conducting new surveys or focus groups, we looked to existing survey and focus group content to provide the community voice. Relevant surveys and focus groups originate with organizations working in child welfare, early education, and any ACEs-related problem. In Richmond, we were able to view the results of a few surveys conducted recently; however, we were not able to access others at the time of this report, which could add to our understanding of the community voice. A summary of the available surveys is presented below.

Overview of Surveys

	Robbins Foundation	United Way of Greater Richmond and Petersburg
Date of Survey	October 2017	
Name of Survey	Portrait of Vulnerable Families & Community Needs in Richmond's Northside	Indicators of community strength
How was the survey conducted (e.g., phone calls, mail-ins, focus groups, etc.)	2 focus groups, Survey questionnaire, Past survey results, Data from Center for Urban and Regional Analysis (CURA), Interviews with organizational leaders serving Northside families	Compilation of survey results were used, including U.S. Census Bureau American Community Survey, United States Geological Survey, and Survey of Income and Program Participation

	Robbins Foundation	United Way of Greater Richmond and Petersburg
What population was surveyed (e.g., teachers, service providers, other professionals, or actual community members)	Families with young children, Organizational leaders serving Northside families	Community members
Location in the Richmond community of survey/focus group participants (if known)	Northside Richmond - located north of I-64 and east of I-95.2 A demographically and socioeconomically diverse area, it includes 23 distinct neighborhoods.	Covering the entire Richmond area
Link to Survey Results Tab	http://www.robinsfdn.org/wp-content/uploads/2018/06/Northside-Report-v8-no-append.pdf	https://www.yourunitedway.org/wp-content/uploads/2017/11/2017-18-Indicators-Report-FINAL-11-13-17.pdf
Question/Indicator 1	Why is the need for vulnerable children and families urgent in the Northside?	Basic needs met: Food, safety & housing
Question/Indicator 2	What are families' priorities, experiences, and perceptions of the needs and assets regarding their young children?	Born healthy
Question/Indicator 3	What are families' priorities, experiences, and perceptions of their needs and assets within their daily lives (i.e., housing, food, health, transportation, safety)?	Prepared for kindergarten
Question/Indicator 4	What are families' access to and relationships with social and community supports that might enhance both the quality of their daily lives and their capacity to support their children?	Grade Level Reading by 3rd Grade
Question/Indicator 5		Middle School Engagement
Question/Indicator 6		High School Graduation
Question/Indicator 7		College or Career Ready
Question/Indicator 8		Financial Well-being
Question/Indicator 9		Connected & Healthy Older Adults

Survey Responses: Robbins Foundation – Northside

Why is the need urgent in the Northside?	What are families’ priorities, experiences, and perceptions of needs and assets regarding their young children?
Community Barriers for Vulnerable Families	Personal Barriers to Addressing Needs
Concentrated Poverty, Neighborhood Distress and Lack of Racial Integration	Community Isolation
Insufficient Quality Child Care	Lack of Trust
Mixed Performance on 3rd Grade School Tests	Pervasive Trauma and Extreme Stress
Concerns about Community Violence	Limited Sense of Self-Efficacy

Survey Responses: United Way

Basic Needs Met: Food, Safety, & Housing		Born Healthy	
Poverty	1 in 9 people live below the poverty thresholds. Poverty decreased (-1.1%) to 11.7% in 2015, the lowest percentage since 2010 and down from a 15-year high of 12.8% in 2013.	Birth Weight	Low birth weight percentage 8.7%
Children Living Below Poverty Thresholds	1 in 7 children live below poverty thresholds in the Greater Richmond and Petersburg region	Prenatal Care	Percent of Women who received prenatal care in the first 13 weeks
Homelessness	From January 2015 to January 2017, the count of people experiencing homelessness went from 818 to 662	Births to Mothers with less than a 12th Grade Education	2015 Percentage 17.9%
Violent Crime Rate	Incident Rate for Richmond (per 1,000 residents) 2010 107.2 to 2016 87.0	Teen Pregnancy	Teen Pregnancy Rate (per 1,000 females 10-17) 14.5%
Child Abuse and Neglect Rate	Founded Child Abuse and Neglect Rate (per 1,000 children under age 18) 2012 1.5 to 2016 2.1		
Food Access	Food Insecurity Rate Richmond - 21.3%		
Prepared for Kindergarten		Grade-level Reading by 3rd Grade	
PALS-K Benchmarks	75% of kindergarteners meeting fall PALS-K benchmarks (lowest rate in the state)	Percent of 3rd graders passing reading	Richmond pass rates decreased from 61.2% in 2016 to 57.8% in 2017 and this was the lowest in the region, with 82.9% in New Kent being the highest.
Health Insurance Coverage	Children (0-5) without health insurance 4.9%	Chronic Absenteeism	Percent of Elementary School Student Chronically Absent 12.5%, with a regional average of 7.1%.
Early Childhood Education (Ages 3-4)	Children enrolled in programs 51.2%		
Early Intervention Programs	279 children receive Part C Intervention Services		

Middle School Engagement		High School Graduation	
Eighth Grade Reading SOL Scores	Percent of Eighth Graders Passing Reading 44.7%, with a 73% being the regional average	On Time High School Graduation Rate	Rate in Richmond is 80.5% with a 90.1% being the regional average
Eighth Grade Math SOL Scores	Percent of Eighth Graders Passing Math 40.2% with the state average of 73.7%	High School Drop-out Rate	Rate in Richmond is 18% with a 6.9% Regional Average
Chronic Absenteeism	Percent of Middle School Students Chronically Absent (Missing More than 10% of School Days) 23.5%, the highest in the region, with a Regional Average of 8.1%	Chronic Absenteeism	Percent of High School Students Chronically Absent 42.2% with a 13.1% Regional Average
Suspensions and Expulsions	Percent of Middle School Students Suspended or Expelled 38.1% with a 12% Regional Average	Juvenile Crime	Total Juvenile Arrests 252 (Arrest Rate 17.1%)

College or Career Ready		Financial Well-Being	
Labor Market Participation Among Adults 25-64	Richmond 77% in labor force, 23% Not in Labor Force Regional Average 80.7% in Labor Force, 19.3% Not in Labor Force	Asset Poverty	Richmond Asset Poverty Rate 38.3% with a State Average of 20.2%
Educational Attainment	Richmond 83.2% High School Diploma/GED or Higher; 41.4% Associate or Higher; 36% Bachelors or Higher; Regional Averages: 88.6% HS/GED or Higher; 42.6% Associate or Higher; 35.7% Bachelors or Higher	Unbanked and Underbanked Households	Richmond households with neither a checking or savings account 12.4% with a State Average of 4.6% Richmond Households Using Alternative Financial Services such as Payday Loans 22.6% with a State Average of 19.7%
FAFSA Completion	Percent of Seniors Completing FAFSA form Richmond: 68.8% Regional Percentage: 55.5%	Unemployment Rate	Richmond: 4.6% Regional Average: 4%
Higher Education Enrollment	Percent of students enrolled in Higher Education within 16 Months of Graduation in Richmond: 53.5% Regional Average: 69.5%	Population Living Below 200% Of Poverty Thresholds	Richmond: 45.8% Regional Average: 27.3%
		Children Living Below 200% of Poverty Thresholds	Richmond: 61.1% Regional Average: 34.7%

Households Spending more than 30% of Income on Housing	Richmond Home Owners: 32.4%
	Regional Average: 25%
	Richmond Renters: 56.2%
	Regional Average: 51%

Other Survey Summaries

The Capital Region Collaborative's Resident Survey Results and Healthy Community Workgroup Report 2018

The Capital Region Collaborative evolved from discussions between Chamber RVA and the Richmond Regional Planning District Commission to launch a regional effort to engage government, business, and community stakeholders in prioritizing and implementing actions that will enhance the quality of life in the Richmond Region.

Through a series of 10 focus groups, 85 public conversations, and telephone and online surveys, more than 8,000 voices came together and identified eight priorities for the region – education, workforce preparation, job creation, social stability, healthy community, coordinated transportation, the James River, and quality place.

<https://www.capitalregioncollaborative.com/wp-content/uploads/2018/03/Snapshot-2018-for-web.pdf>

Bon Secours Community Health Needs Assessment 2016

The Bon Secours Health System serves the larger Richmond, Virginia metropolitan area and includes four hospital facilities whose patients largely consist of Richmond's residents. As a non-profit hospital system, Bon Secours held a community health needs assessment (CHNA) to adopt an implement strategy to maintain their 501(c)(3) status under the Affordable Care Act.

The CHNA process included an online survey to assess community needs and three community conversations within city limits. The CHNA quantitative and qualitative data, along with input from the Advisory Board, was shared with the Bon Secours Richmond administration, who then identified four needs to address: access to care for uninsured individuals with chronic disease conditions, mental health, education, and transportation.

https://bonsecours.com/library/community-involvement/richmond/bsr-chna_final-august2016.pdf?la=en

City of Richmond Prescription Drug/Heroin 2016 Needs Assessment

This needs assessment was conducted by Richmond Behavioral Health Authority/Friends of Prevention Coalition as part of the Substance Abuse Block Grant/Partnership for Success grant in 2016 to identify needs and assets related to prevention of Heroin use in City of Richmond. The FOPC collected data from October 2015- November 2016 utilizing assessments, quantitative data sources, and survey data from young adults and middle and high school students.

The results of this needs assessment implicated prescription drug misuse and heroin misuse, specifically among 10-25 year olds in the City of Richmond, as two priority areas for future efforts. The Virginia State Health Commissioner Dr. Marissa Levine declared the rising opioid crisis as a public health emergency in 2016. As a result of this declaration, a focus on opioid prevention as risen to the top of Richmond's priority list.

<http://www.vdh.virginia.gov/content/uploads/sites/119/2017/09/RCHD-CHA-Aug-2017.pdf>

Coalition Details

Next, we present existing coalitions, collective impact initiatives, and other conveners of local experts for prevention activities. The goal of this step is to understand the current prevention services landscape and identify areas of overlap in content, mission, messaging, and/or programming. Such areas provide opportunities for collaboration so resources can be leveraged in order to increase their impact and so better serve the people of Richmond.

Prevent Child Abuse Virginia (PCAV) – Families Forward			
Organizer and Champions	Subject Matter Expert (Local Go-Go Experts)	Institutional Backers	Funding Sources
PCAV has 50 affiliates in VA including the CASA and CAC. They provide training, program evaluation, and other types of support at the state level.	Lisa Specter-Dunaway (CEO)		Public and private funding
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
Child Sexual Abuse Prevention; Statewide Parent Support & Education; Federal, State and Local Advocacy; Public Awareness and Education; Competency-Based Statewide Professional Development; and Evidence Based Home Visiting Programs (Healthy Families, CHIP, Parents as Teachers, Nurse Family Partnership, and "Family lifeline")			Nothing specific to Richmond

Children's Advocacy Center			
Organizer and Champions	Subject Matter Expert (Local Go-To Experts)	Institutional Backers	Funding Sources
Greater Richmond SCAN	Jeanine Harper Kristen Byrd	Greater Richmond SCAN	SCAN receives donations from individuals, corporations, congregations, civic organizations and private foundations. Funding is also provided through special events, state government grants, and contributions from local governments.
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years

Fund of Virginia

<https://www.acesconnection.com/g/greater-richmond-va-trauma-informed-community-network-ticn/blog/virginia-statewide-trauma-informed-community-networks>

Child Abuse Pediatrics

Organizer and Champions	Subject Matter Expert (Local Go-To Experts)	Institutional Backers	Funding Sources
The Child Protection Team evaluates, diagnoses and treats children who have been sexually or physically abused or neglected	Dr. Robin Foster, Director; Caroline Barrow Compton, LCSW; Shamika M. Byars, Pediatric Nurse Practitioner; Emily Horne, Pediatric Nurse Practitioner	Three hospital systems (Bon Secours, VCU Health and HCA); Children's Hospital of Richmond at VCU; Child Protective Services; and Law enforcement	Children's Hospital of Richmond at VCU
Current Campaigns	Current Goals / Deliverables and Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years

CASA (Court-Appointed Special Advocates)

Organizer and Champions	Subject Matter Expert (Local Go-To Experts)	Institutional Backers	Funding Sources
Together with its state and local member programs, CASA supports and promotes court-appointed volunteer advocacy.	Bill Collins, Board Chair Tara Perry, Chief Executive Officer	Partners: Kappa Alpha Theta; Office of Juvenile Justice and Delinquency Prevention; Jewelers for Children; The Toy Foundation	
Current Campaigns	Current Goals / Deliverables and Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years

Sex Trafficking

Organizer and Champions	Subject Matter Expert (Local Go-To Experts)	Institutional Backers	Funding Sources
<p>1. Richmond Justice Initiative (RJI) is a non-profit, Christian faith-based organization that works locally and nationally to eradicate sex trafficking. 2. Replenish Richmond is a for-profit community development organization emphasizing the development of the people of the Community of Richmond. 3. Global Centurion Foundation is a nonprofit organization fighting human trafficking. 4. The Kids Are Not For Sale in Virginia Coalition 5. ImPACT People Against Child Trafficking in American Schools</p>	<p>Jessica Willis, CEO, RJI; Joell Maisano Denison, Director of Programs and Training</p>	<p>Laura Lederer, Global Centurion Foundation; Rick Tatnall, Replenish Richmond; Shared Hope International ImPACT Virginia: People Against Child Trafficking in American Schools</p>	<p><i>RJI: Supported through the voluntary generosity of individuals, churches, foundations, and businesses.</i></p>
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
<p><i>RJI: The Prevention Project; VDSS Sex Trafficking Training Module; and Virginia Takes The Lead (VTTL), (Global Centurion & Replenish Richmond)</i></p>		<p>Delegate Tim Hugo and Sen. Mark Obenshain sponsored HB 1964 and SB 1188, establishing Virginia's first standalone sex trafficking law. The Kids Are Not For Sale in Virginia Coalition</p>	

Homelessness

Organizer and Champions	Subject Matter Expert (Local Go-To Experts)	Institutional Backers	Funding Sources
<p>The Virginia Homeless Solutions Program (VHSP)</p>	<p>Nichele Carver: VHSP Program Contact</p>	<p>Homeless Prevention Services (Kelly King Horn) from Homeward. Public housing authority.</p>	<p>The Virginia Department of Housing and Community Development (DHCD), state and federal funding</p>
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
	<p>1. To reduce the number of individuals/households that become homeless;</p>		

2. To shorten the length of time an individual or household is homeless; and
3. To reduce the number of individuals/households that return to homelessness.

Elder Abuse

Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
<ol style="list-style-type: none"> 1. Prevent Elder Abuse Richmond (PEAR): Increase awareness of the prevalence of domestic, sexual, and family violence in the lives of women aged 50 and older. 2. VDSS: Adult Services (AS) 3. Senior Connection 		Richmond City DSS PEAR Taskforce (Behavioral Health Authority; Commonwealth Attorney’s Office; Department of Social Services, Domestic Violence Fatality Review Team; Multidisciplinary Team on Domestic Violence and Elder Abuse; Police Department, Sheriff’s Office; and Victim Witness Assistance Program)	
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
Task Force On Domestic Violence in Later Life	<ol style="list-style-type: none"> 1. Understand the types and dynamics of abuse in later life; 2. Discover resources available from professionals in other disciplines; 3. Better understand the different roles of those disciplines; 4. Create avenues to find new and innovative solutions to improve systems for the victims’ benefit; and 5. Join forces with partners to assist all agencies in improving coordinated care and placing the person first. 		Key Senior Statistics: https://www.senior-care.com/directory/va/richmond/

Injury Prevention (Child and Adult)

Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Project Empower: Injury and Violence Prevention Program	1. Dr. Michel B. Aboutanos, Director, Injury & Violence Prevention Programs 2. Amy Vincent, Assistant Director, Injury & Violence Prevention Programs	VCU Health	VCU Health, Shining Knight Gala Funds Injury and Prevention Programs in the Central Virginia Community
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
	Project EMPOWER is a multi-disciplinary initiative dedicated to enhancing prevention and intervention services to those individuals and their families who have experienced intimate partner violence (IPV) or sexual violence (SV). It provides direct services to its patients and team members as well as training for its healthcare providers.		

Drug Misuse (Opioid and Otherwise)

Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Dr. John P. Lindstrom, CEO, Richmond Behavioral Health Authority	1. Dr. James C. May, Director of Planning, Development, Research, Evaluation & Substance Use Disorders Services 2. Amy Erb, Director of Regional Programs	Virginia Department of Behavioral Health & Developmental Services Central Office; Richmond Police Department	The Richmond Behavioral Health Foundation (RBHF)
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
		The Governor’s Task Force on Prescription Drug and Heroin Abuse in Virginia presents CurbTheCrisis.com	Annual Report: http://www.rbha.org/sites/default/files/RBHA%20FY16%20Annual%20Report.pdf

Violence Prevention

Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
<p>1. Virginia Department of Health 2. The Juvenile Justice Collaborative 3. Virginia Center for Inclusive Communities 4. Youth Violence Prevention Program 5. Richmond Family and Fatherhood Initiative, which is made up of a core team comprised of different organizations and different backgrounds.</p>	<p>1. Stephanie Sakyi (YVPP) 2. Anthony J. Mingo, Sr. (RFFI)</p>	<p>ChildSavers; Communities in Schools of Richmond; Department of Juvenile Justice; 13th District Court Service Unit; Greater Richmond SCAN; Peter Paul Development Center/Richmond Promise Neighborhoods; Richmond Behavioral Health Authority; Richmond DCAO of Human Services; Richmond Department of Justice Services; Richmond Department of Parks, Recreation, and Community Facilities; Richmond Department of Social Services; Richmond Police Department; Richmond Public Schools; Richmond Redevelopment and Housing Authority; VCU Clark-Hill Center for Positive Youth Development; VCU Trauma Center & Injury and Violence Prevention Program; Virginia Center for Inclusive Communities; YWCA of Richmond; and Department of Juvenile Justice.</p>	<p>CDC-funded Youth Violence Prevention Training and Technical Assistance Grant from the American Institute for Research (AIR).</p>

Suicide Prevention			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
1. The Virginia Sexual & Domestic Violence Action Alliance 2. Hunter Holmes McGuire VA Medical Center 3. Suicide Prevention Resource Center	1. Richmond VA Medical Center: Laura Pond, LCSW Suicide Prevention Coordinator 2. Richmond Behavioral Health: Charlene Edwards 3. Department of Behavioral Health & Developmental Services: Nicole Gore, Suicide Prevention Coordinator 4. Virginia Department of Health: Anya Shaffer, MPA, Violence and Suicide Prevention Coordinator	Local "Community Service Boards," or Richmond Behavioral Health Authority	
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
			VA Suicide Prevention Plan Survey: http://www.sprc.org/sites/default/files/Virginia%20Suicide%20Prevention%20Across%20the%20Lifespan%20Plan.pdf

Maternal Morbidity / Mortality			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Virginia's Maternal Mortality Review Team: Dr. Walker Harris, Director of Office of Family Health Services	Melanie J. Rouse, PhD, Maternal Mortality Projects Coordinator	Virginia Department of Health Office of the Chief Medical Examiner	Title 5
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
Chronic Disease Report	1. Identify all pregnancy-associated deaths in the Commonwealth and the development of interventions that reduce preventable deaths. 2. Tracking chronic disease data to make recommendation: November deadline	Medicaid Expansion	Maternal Mortality Research: https://www.sciencedirect.com/topics/medicine-and-dentistry/maternal-mortality

Infant Mortality			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Central Region Child Fatality Review Team	Monica Hockaday	Infant and Child Death Virginia Department of Health Office of the Chief Medical Examiner	
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
Children’s Health and Safety: Virginia Programs: http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/child-fatality-review-in-virginia/additional-re-sources/			Infant Mortality Trends: http://www.vdh.virginia.gov/content/uploads/sites/18/2018/05/Infant-Mortality-Trends-in-Virginia-2014-2016.pdf Child Fatality Reports: http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/child-fatality-review-in-virginia/reports/

Poverty			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Maggie L. Walker Initiative for Expanding Opportunity and Fighting Poverty; The Anti-Poverty Commission	Reggie Glover; Valaryee Mitchellin, The office of Community Wealth Building	Community advocates, academics, community leaders, members of the business sector, and other stakeholders	Office of Community Wealth Building

Early Childhood Education (School Readiness, 3rd Grade Reading Levels)

Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backer	Funding Sources
Richmond Early Childhood Cabinet, Communities in Schools: Richmond, NextUp	Stephanie Glenn, Program Manager, HandsOn Greater Richmond	1. Office of Community Wealth Building (OCWB) 2. Richmond Department of Human Services 3. Richmond Public Schools 4. Communities In Schools of Richmond 5. Richmond Public Library	1. Richmond Early Childhood Alignment Project \$300,000 (July 1, 2015 - June 30, 2018) 2. Community Foundation for a Greater Richmond
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
	The goal of the Citywide Early Childhood Development Initiative is for all Richmond City children aged zero through five to be healthy, well-cared for, and ready to succeed in school. Achievement of the goal will be supported by strategies in five focus areas: 1. Public Awareness, 2. Quality Child Care, 3. Parent Education, 4. Evaluation and Benchmarking		Early Childhood Development Initiative: http://www.richmondgov.com/EarlyChildhoodDevelopment/documents/EarlyChildhoodDevelopmentConceptPaper.pdf , Early Childhood Data&Policy: http://www.vecf.org/reports-and-tools/

Foster Care

Organizer and Champions	Subject Matter Experts (Local Go-To Expert)	Institutional Backers	Funding Sources
Richmond City Department of Social Services, Carl Ayers	Carl Ayers, Elizabeth Overall Lee	Federal Government and Virginia state	Federal, State, and Local funding

Disability Services			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
1. John Walker, CEO, The Greater Richmond ARC 2. Heidi L. Lawyer, Virginia's Developmental Disabilities (DD) Council	Penni Sweetenburg-Lee	State	ARC-Donors, volunteers, government and corporate partners. In total, more than \$13 million was invested in programs for individuals with disabilities.
Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
			1. ARC Annually Community Report: https://static1.squarespace.com/static/597e46d1f9a61e963da73376/t/5b462c80f950b77c7427f3f3/1531325571012/31530%2BARC%2B2017%2BAR%2B060518.pdf 2. Virginia's Developmental Disabilities Council Annual Reports and surveys: https://www.vaboard.org/

Trauma-Informed Care Greater Richmond Trauma-Informed Community (TICN)			
Organizer and Champions	Subject Matter Experts (Local Go-To Experts)	Institutional Backers	Funding Sources
Jeanine Harper, Executive Director, Greater Richmond SCAN	Lisa Wright, Trauma-Focused Treatment (TFT) Program Coordinator	Children's Mental Health Resource Center; ChildSavers; Coordinators2inc; Family Preservation Services, Inc.; Family and Children's Trust Fund of Virginia; Greater Richmond SCAN (Stop Child Abuse Now); VCU School of Education; VCU School of Social Work; and Virginia Department of Social Services	

Current Campaigns	Current Goals / Deliverables & Timeline	Legislative Priorities	Surveys Conducted Within The Last Five Years
	Highlights of Current Effort: http://grscan.com/wp-content/uploads/2016/01/TIC-N-handout.pdf		

Subject Matter Experts and Potential Champions

Advocates for Richmond Youth

Dr. Alex Wagaman
 Facilitator
 Youth Homelessness
<https://rampages.us/advocatesforrichmond-youth/>
mawagaman@vcu.edu

Alliance for Progressive (Values) Virginia

Scott Price
 Policy Director
 Economic fairness, social justice, and fair government practices
<http://apvonline.org/>
info@apvonline.org

Altria

Supporting Youth Development, Protecting the Environment, Civic Engagement, Arts & Culture, Employee Engagement and Humanitarian Aid & Military Support
www.altria.com

American Foundation for Suicide Prevention (AFSP) Virginia chapter

Kathe Goller
<https://afsp.org/chapter/afsp-virginia/>
kgoller@afsp.org
 (540) 447-0113

BHC: Better Housing Coalition

Joyce Jackson
 Vice President, Community Social Work
 Neighborhood Restoration Using a Mixed-Income, Mixed-Use Model That Prioritizes Sustainability

www.betterhousingcoalition.org
jjackson@betterhousingcoalition.org
 804-644-0546

Big Brothers Big Sisters

Ann Rohde Payes
 Executive Director
 Social skills, academic achievement, and healthy living
www.bigbrobigsis.com www.bbbs.org
apayes@bigbrobigsis.com
 804-261-494

Blue Sky Fund

David Kunnen
 Executive Director
 Academic success with a focus in the sciences and development of character and leadership skills.
www.blueskyfund.org
david@blueskyfund.org
 804-241-8479

Bon Secours: Health System

John M. Starcher, Jr., Esq.
 President/CEO
 Community health services, Diversity & inclusion, Health care ethics and spiritual care services
<https://bonsecours.com/richmond>
 410-442-5521

Boy Scouts, Heart of VA Council

George M. McGovern
 Scout Executive

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Community involvement and service projects that support the values and aim of Scouting to train youth in responsible citizenship.

hovc.org/
georgem.mcgovern@scouting.org
804-204-2611

Boys & Girls Club of Metro Richmond

Todd McFarlane
President/CEO
<https://www.bgcmr.org/>
tmcfarlane@bgcmr.org
(804) 359-5250 x224

Bridging Richmond

Jason Smith
Partnership Executive Director
Richmond Data
smithjw4@vcu.edu

CAHN: Capital Area Health Network

Tracy Causey
CEO
Primary care health services, dental, health education, specialty clinics
<http://cahealthnet.org/>
804-780-084

Capital Diaper Bank

Phyllis Bradley
CEO
Infants/babies, family health/well-being
www.capitaldiaperbank.org
info@capitaldiaperbank.org
833-782-2229

CAPUP: Capital Area Partnership Uplifting People

Thomas D. Wagstaff
President/CEO
Youth, Adult & Senior Services, Emergency services, Food buying club
www.capup.org
info@capup.org
(804) 788-005

CARITAS

Karen Stanley
President/CEO

Homelessness and Addiction

www.caritasva.org
kstanley@caritasva.org
(804) 887-1577

Carol Adams Foundation

Carol Adams
President/CEO
Safety, Domestic and/or sexual violence, Human trafficking, Community outreach, Education, Prevention services
www.caroladamsfoundation.org
cadamsfoundation@icloud.com
(804) 218-2866

CASA

Bill Collins, Tara Perry
Board Chair, Chief Executive Officer

CCC: Commonwealth Catholic Charities

Anita Best
Richmond Manager
Adult guardianship, Foster care, Housing
www.cccofva.org
agency@cccofva.org
804.285.590

Central Region Child Fatality Review Team

Monica Hockaday
CPS Regional Specialist
Child abuse
<http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/child-fatality-review-in-virginia/local-child-fatality-review-in-virginia/>
Monica.Hockaday@dss.virginia.gov
(804) 662-9779

Challenge Discovery Projects

Daniel R. Stembridge, M.P.A.
Executive Director for Administrative Services
Violence and bullying prevention within our city schools, Youth substance use/abuse, and Mental health/substance abuse counseling for the deaf and hard of hearing. These opportunities are provided regardless of a client's ability to pay.
<http://www.challengediscoveryprojects.org/>

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staff@challengediscoveryprojects.org
(804) 282-9100

Change the World RVA

Natalie May
President
Support for homeless youth.
www.changetheworldrva.org
mcguffinkp@mymail.vcu.edu

CHAT: Church Hill Activities & Tutoring

Stephen Weir
Executive Director
Life-giving relationships, Healthy identity & vision for the future, Genuine skills * opportunity
<http://chatrichmond.org/>
stephen.weir@chatrichmond.org
804.644.0518

Child Care Aware

Angela Wirt
Executive Director
Child care
<http://va.childcareaware.org>
angelaw@va.childcareaware.org

Child Care Aware

Donna Foley
Data Services
Data and Virginia child care mapping project
<http://va.childcareaware.org>
donnafoley@va.childcareaware.org

Child Savers

L. Robert Bolling
CEO
Mental well being of children and a positive bond between adult and child.
childsavers.org
rbolling@childsavers.org
(804) 644-959

Children's Home Society of Virginia

Dale Johnson-Raney
Chief Operating Officer
Foster support
<https://chsva.org/>
dale@chsva.org
804-353-0191



Children's Home Society of Virginia

Laura Wiedner
Training and Community Engagement Officer
Foster care/Adoption
<https://chsva.org/>
lauren@chsva.org
(804) 353-0191 ext: 330.

**Children's Hospital of Richmond at VCU:
The Child Protection Team**

Dr. Robin Foster,
Director
Health/Child abuse
<https://www.chrichmond.org/Services/Child-Protection-Team.htm>
robin.foster@vcuhealth.org
(804) 828-9111

**Children's Hospital of Richmond at VCU:
The Child Protection Team**

Elias Neujahr, MHA, MBA
CEO
Health/Child abuse
<https://www.chrichmond.org/Services/Child-Protection-Team.htm>
Elias.Neujahr@vcuhealth.org
(804) 828-9111

**Children's Hospital of Richmond at VCU:
The Child Protection Team, Emergency
Medicine**

Shamika M. Byars
Pediatric Nurse Practitioner
Child abuse prevention and treatment
shamika.byars@vcuhealth.org
804-828-9111

**Children's Hospital of Richmond at VCU:
The Child Protection Team, Emergency
Medicine**

Emily Horne
Pediatric Nurse Practitioner
Child abuse prevention and treatment
<https://chrichmond.org/Provider-Directory/Horne.Emily.htm>
emily.jumet@vcuhealth.org
(804) 828-9111

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Church Hill Academy

Libby Germer
Head of School
Academics, Career Preparation, Life-Skills,
Economic Literacy and Spiritual Development
<http://www.churchhillacademy.org/>
libby.germer@churchhillacademy.org
804.222.8760

CIS: Communities in Schools

Courtney Groves Winters
Development Manager
Drop-out rate
www.cisofrichmond.org
cwinters@cisofrichmond.org
804-358-1247

City of Richmond- Attorney

Allen Jackson
City Attorney
<http://www.richmondgov.com/CityAttorney/index.aspx>
allen.jackson@richmondgov.com

City of Richmond- Attorney

Susan McKenney
Attorney
Community wealth-building attorney
<http://www.richmondgov.com/CityAttorney/index.aspx>
susan.mckenney@richmondgov.com

City of Richmond- Attorney

Bonnie Ashley
Attorney Economic and Community Development
Economic and Community Development
<http://www.richmondgov.com/CityAttorney/index.aspx>
bonnie.ashley@richmondgov.com

City of Richmond- Attorney

Alexandra Griffin
Attorney
Social Services
<http://www.richmondgov.com/CityAttorney/index.aspx>
alexandra.griffin@richmondgov.com

City of Richmond- Attorney

Janet Palmer
Attorney
Social Services
<http://www.richmondgov.com/CityAttorney/index.aspx>
janet.palmer@richmondgov.com

City of Richmond- Attorney

John Bullard
Chief Deputy Attorney
Commonwealth
<http://www.richmondgov.com/CityAttorney/index.aspx>
john.bullard@richmondgov.com

City of Richmond- Attorney

Patricia Batley
City Clerk
Richmond Juvenile and Domestic Relations
District Court
pbatley@vacourts.gov

City of Richmond- Access Data

Charles Lee
Community Health Promotions Director
City data and access to experts from speaker series.
<http://www.vdh.virginia.gov/richmond-city/speakers-bureau/>
Charles.lee@richmondgov.com

City of Richmond- EMS Deputy Director

Anthony McLean
Deputy Director
EMS protocol and data
anthony.mclean@richmondgov.com

City of Richmond- FAPT

Carley Hovermale
FAPT Coordinator
FAPT
<http://www.richmondgov.com/SocialServices/ChildrensServicesAct.aspx>
Carley.hovermale@richmondgov.com

City of Richmond- CSA

Brady Nemeyer
CSA Administrator

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CSA
<http://www.richmondgov.com/SocialServices/ChildrensServicesAct.aspx>
brady.nemeyer@richmondgov.com

City of Richmond- Health Department- Resource Mothers

Samantha Dockery
Program Coordinator
Teen moms
<http://www.vdh.virginia.gov/richmond-city/resource-mothers/samantha.dockery@vdh.virginia.gov>

City of Richmond Department of Fire and Emergency Services

Melvin D Carter
Fire Chief
Public safety
<http://www.richmondgov.com/Fire/index.aspx>
(804)646-250
Commonwealth Catholic Charities
Donald Miller
Development Manager
Adoption, Counseling, Developmental disabilities, Food pantry, Foster care, Guardianship, Housing & financial counseling, Immigration services, Individual & family counseling, Interpreter services, Pregnancy counseling, Refugee resettlement
<https://www.cccofva.org/agency@cccovfva.org>
804-285-5900

Community Food Collaborative

Toby Vernon
Executive Director
Health, wealth, and vitality
www.communityfoodcollaborative.org
info@communityfoodcollaborative.org
804.402.3119

Community Foundation

Sherrie Armstrong
President/CEO
Community Vibrancy, Economic Prosperity, Educational success, health, & wellness
<http://www.tcfichmond.org/>

sbarmstrong@tcfichmond.org
(804) 330-7400

Community Foundation for Greater Richmond

Amy Singleton
VP, Philanthropic Services
Early childhood education
<https://www.cfrichmond.org/>
asingleton@cfrichmond.org
804-409-5613

Community Foundation for Greater Richmond

Stephanie Glenn
Program Manager, HandsOn Greater Richmond
Early childhood education
<https://www.cfrichmond.org/>
sglenn@cfrichmond.org
(804) 409-5595

Community Foundation for Greater Richmond

Gregory Gallop
Community Engagement Officer
Early childhood education
www.cfrichmond.org
ggallop@cfrichmond.org
804-409-5610

Concerned Black Men

Career and Academic Development, Cultural Awareness, personal growth, and recreation
<http://www.cbmrichmondva.org/>
cbmrichmond@gmail.com

Cross Over Ministries

Julie Bilodeau
Chief Executive Officer
Family practice and specialty services; Mental health counseling
www.crossoverministry.org
jbilodeau@crossoverministry.org
(804) 655.2794, ext. 114

Daily Planet Health Clinic

Maureen Neal
Chief Operating Officer, Advancement

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<https://dailyplanetva.org/>
nealm@dailyplanetva.org

Department of Behavioral Health & Developmental Services

Nicole Gore
Suicide Preventions Coordinator
Suicide prevention
<http://www.dbhds.virginia.gov/behavioral-health/suicide-prevention>
Nicole.Gore@dbhds.virginia.gov
(804) 786-3921

DHCD: VA Dept. of Housing & Community Development

Tamarah Holmes
Associate Director of Community Development Policy
Housing, Home owner & buyer assistance, Homeless prevention, Tax credit programs, Housing development, Manufactured housing (MH) and neighborhood stabilization program (NSP)
www.dhcd.virginia.gov/
tamarah.holmes@dhcd.virginia.gov

Diversity Richmond

Bill Harrison
President/CEO
Social change, Inclusivity, Education, Advocacy, Financial support
<http://diversityrichmond.org/>
bill.harrison@diversityrichmond.org
804-622-4646

Drums Not Guns

Michael Mills
Founder/Executive Director
Bullying, Hunger, Homelessness, Violence/crime & substance abuse prevention, Literacy, Heritage
drumsnoguns.org
mz445clo3@yahoo.com
(203) 675-4827

East End Youth Basketball

Makon Fletcher
Founder/President

Athletics, Teamwork, Sportsmanship, Education and Life Skills
www.leaguelineup.com/welcome.asp?url=eeyb
EastEndYouthBasketball@yahoo.com

Embrace Richmond

Wendy McCraig
Executive Director
Training, Coaching, Youth development, Great neighbor project
<http://embracerichmond.org/>
wendy@embracerichmond.org
(804)404-3610

Enrichmond

John Sydnor
Citizen involvement, Education, and Fundraising
enrichmond.org
enrichmond.org/contact/
(804) 234-3905 x109

Equality Virginia

Trace Hernandez
Program Coordinator
Parenting, Safe & inclusive schools, Non-Discrimination, Relationship recognition, Legal cases
<https://www.equalityvirginia.org/>
thernandez@equalityvirginia.org

Families are Magic

Melissa McGinn
Families
<http://www.famrichmond.org/>
mmcginn@grscan.org
804-257-7226

Family and Children's Trust Fund of Virginia

Nicole Poulin
Family and children
www.fact.virginia.gov
nicole.poulin@dss.virginia.gov
804-726-7604

Family Life Line*

Victoria Harris

RICHMOND, VIRGINIA
TECHNICAL REPORT



Community Liasion
Prenatal & infancy, Children, Adolescents,
Adults, Older adults
[http://www.familylifeline.org/
referrals@familylifeline.org](http://www.familylifeline.org/referrals@familylifeline.org)
804-249-5414

Farm to Family

Mark Lilly
Founder
Planting, Harvesting, Cooking, Preserving,
Construction, Composting, Soil building, Bee
Keeping, Vermiculture, Aquaponics, Retail
Marketing and Entrepreneurship
[http://thefarmbus.com/
farmtofamilyinfo@gmail.com](http://thefarmbus.com/farmtofamilyinfo@gmail.com)
804-767-8570

Feed More Central Virginia Food Bank

Doug Pick
President and CEO
Hunger prevention
www.feedmore.org
dpick@feedmore.org
(804) 521-2500

Friends Association for Children

J. David Young
Executive Director
Literacy, Education, Citizenship, Social, Emo-
tional and intellectual skills, Leadership
<https://friendsrva.org/>
dyoung@friendsassn.org
804- 644-2357

**Future Business Leaders of America - Cap-
ital Region**

Sandy Mills
FBLA-PBL Specialist
Student leadership
vafbla-pbl.org
smills@vafbla-pbl.org
540-686-1105

Girl Scouts of the Commonwealth of VA

Mary Black
Chief Operating Officer
STEM, Community service, Entrepreneurship,
Life skills

www.comgirlscouts.org
mblack@comgirlscouts.org
(804) 746-0590 ext. 380

Girls for a Change

Angela Patton
CEO
Before & after school programs, Girls who
code RVA, Girl ambassador program, Camp
diva
<http://www.girlsforachange.org>
ashleem@girlsforachange.org
(804)420-2267

**Global Centurion -Virginia-based anti-traf-
ficking organization**

Laura Lederer
President
Sex trafficking
[https://www.globalcentu-
rion.org/about/about/](https://www.globalcenturion.org/about/about/)
llederer@globalcenturion.org
(703) 919-6828

Gray Haven

Andrea Bailey
Co-founder
Human trafficking
thegrayhaven.org
info@thegrayhaven.org

Greater Richmond SCAN

Lisa Wright
Program Coordinator
Child abuse prevention
www.grscan.com
lwright@grscan.com
(804) 257-7226

Greater Richmond SCAN

Jeanine Harper
Executive Director
Child abuse prevention
www.grscan.com
jharperscan@aol.com
(804) 257-7226

Greater Richmond SCAN

Sarah Mersereau

RICHMOND, VIRGINIA
TECHNICAL REPORT



Community engagement coordinator
Child abuse prevention; Community partnerships
www.grscan.com
smersereau@grscan.com

Greater Richmond SCAN
Lisa Wright, LCSW, RPT-S
Trauma Focused Coordinator
Child abuse prevention; Trauma
www.grscan.com
lwright@grscan.com

Greater Richmond SCAN
Jessica Moore
Richmond CASA- Program Coordinator
Child abuse prevention
www.grscan.com
jessica.moore@richmondgov.com,

Greater Richmond SCAN
Melissa McGinn
Community Programs Coordinator
Child abuse prevention; Community partnerships
www.grscan.com
MMcGinn@grscan.com

Greater Richmond SCAN
Angela Borsella, PhD
Family Support Program Coordinator
Child abuse prevention; Family programming
www.grscan.com
aborsella@grscan.com

Groundwork RVA
Rob Jones
Executive Director
Greening Richmond, Preparing Youth for Success, Improving health & quality of life of all residents, Realizing racial equity
groundworkrva.org
info@groundworkrva.org
804.321.2789

Habitat for Humanity/Richmond Metropolitan
Jane Helfrich
CEO

Housing
www.richmondhabitat.org
jhelfrich@richmondhabitat.org
804.232.7001 x102

HandsOn Greater Richmond
Stephanie Glenn
Program Manager
Volunteer
<https://www.handsonrva.org/volunteer@handsonrva.org>
(804) 409-5618

Health Brigade
Karen Legato
Executive Director
Health
healthbrigade.org
klegato@healthbrigade.org
804-358-6343

Home Again
Lorae Ponder
Executive Director
Homelessness
<https://www.homeagainrichmond.org/INFORM@HOMEAGAINRICHMOND.ORG>
804-358-7747

HOME: Housing Opportunities Made Equal
Heather Mullins Crislip
President/CEO
Housing counseling and education, Fair housing, Housing policy, Research
homeofva.org
hcrislip@homeofva.org
804.354.0641 ext 108

Homeward
Identifying Needs and Trends, Serving as a Community Catalyst for Change in Service Delivery, Educating the community for system change
homewardva.org
mackermann@homewardva.org
804-343-2045

Housing Families First

RICHMOND, VIRGINIA
TECHNICAL REPORT



Beth Vann-Turnbull
Executive Director
Assist families in finding permanent housing
and access to support services needed to sustain
housing.
www.housingfamiliesfirst.org
terri@housingfamiliesfirst.org
804-236-580

Impact 100

Talley Baratka
Founder
Arts and Culture, Education, Environment &
Sustainability, Family, Health & wellness
impact100rva.org
membership@impact100rva.org
(804) 330-7400

**IMPACT People Against Child Trafficking
in American Schools**

Fay Chelmow
President/Founder
Sex trafficking
<http://www.impactvirginia.org/>
fay.chelmow@IMPACTvirginia.org
617-877-5074

**Infant and Child Death: Virginia Depart-
ment of Health**

Allison Clevenger
Projects Coordinator
Child abuse prevention
[http://www.vdh.virginia.gov/medical-exam-
iner/fatality-review-surveillance-programs-
reports/child-fatality-review-in-virginia/](http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/child-fatality-review-in-virginia/)
Allison.Clevenger@vdh.virginia.gov
804.205.3854

Injury and Violence Prevention

Amy Vincent
Assistant Director
Injury and violence prevention
[https://www.vcuhealth.org/services/injury-
and-violence-prevention/ivpp-staff-contact-
info](https://www.vcuhealth.org/services/injury-and-violence-prevention/ivpp-staff-contact-info)
Amy.vincent@vcuhealth.org
800-762-6161

Jewish Community Federation

Daniel Staffenberg
Chief Executive Officer
Fundraising, Community planning, Leadership
development, and Outreach
jewishrichmond.org
dstaffenberg@jewishrichmond.org
804-545-8622

Jubilee Family Development Center

Sterling Wilder
Executive Director
Family/Community development
<https://www.jubileefamily.org/>
swilder@jubileefamily.org
434-845-0433

Junior Achievement

Daphne Swanson
President/CEO
Economic success
www.jatoday.org
dswanson@JAtoday.org
(804) 217-8855

Junior League of Richmond

Jayda Justus
President
Diversity and inclusion, Advisory boards com-
munity programs, Community partners
www.jlrichmond.org
president@jlrichmond.org
804.643.4886

KABOOM

Caroline Finnell
Communications
Healthy spaces for youth
kaboom.org
cfinnell@kaboom.org
(202) 659-0215

Kinfolks Community

Health, Financial well-being
<https://kinfolkcommunity.org/>
kinfolksrva@gmail.com

Kiwanis International - Heart of Virginia

Christy
Support for youth

RICHMOND, VIRGINIA
TECHNICAL REPORT



kiwanis.org
richmondkiwanis@comcast.net
(804) 447-3769

Legal Aid Justice Center

Angela Clofl
Director of Litigation and Advocacy
Housing, Education, Civil rights, Immigration,
Healthcare and consumer finance
justice4all.org
angela@justice4all.org
(804) 643-1086

Lions Club

Dane LaJoye
Division Manager, PR & Communications
Diabetes, Environment, Hunger relief, Pediatric
cancer and vision
www.lionsclubs.org/EN/index.php
pr@lionsclubs.org
(630) 468-6764

LISC: Local Initiative Support Corporation

Candice Streett
Executive Director
To equip talent in the underinvested.
Strengthen existing alliances while building new
collaborations to increase our impact on the
progress of people and places in the Richmond
area.
lisc.org
cstreett@lisc.org
(804) 505-4703 ext. 4

Mayor of Richmond - Levar Marcus Stoney

Lincoln Saunders
Chief of Staff
<http://www.richmondgov.com/Mayor/Staff.aspx>
Lincoln.Saunders@richmondgov.com
(804) 646-7970

Micah Initiative

Joel T. Blunk
Co Pastoral Director
Supporting the Students of Richmond Public
Schools
<http://micahrva.org/about/>
micah@richmondhillva.org

804-783-7903 Ext. 30

Minority Health Consortium

Juan Pierce
Executive Director
Enhancing healthier lifestyles of minorities
through outreach, education, prevention, and
testing.
<http://www.mhcprevents.org/>
<http://www.mhcprevents.org/Contact.html>
(804) 225-0820

NAACP: National Association for the Advancement of Colored People

Eris T. Sims
Chief of Staff
Economic stability, Education, Health, Public
safety and Criminal justice, Voting rights and
Political representation, Expanding youth and
young adult engagement
<http://www.naacp.org/>
secretary@henriconaacp.org

Nurse Family Partnership Western Tidewater Health District NFP Program

Kimberly Boone
Local Director
<https://www.nursefamilypartnership.org/locations/virginia/>
kimberly.boone@vdh.virginia.gov
757-514-4727

Nurse Family Partnership Western Tidewater Health District NFP Program

Meredith Taylor
Program Support Technician
Families
<https://www.nursefamilypartnership.org/locations/virginia/>
meredith.taylor@vdh.virginia.gov
757-514-4727

Office of Community Wealth Building

Reggie Gordon
Director
Poverty
<http://www.richmondgov.com/CommunityWealthBuilding/index.aspx>
reginald.gordon@richmondgov.com

RICHMOND, VIRGINIA
TECHNICAL REPORT



(804) 646-637

Partners in Parenting

Jennine Moritz
Founder
Parenting
<https://www.piprva.com/>
info@piprva.com
804-442-7192

Partnership For Families

Veronica Fleming
Executive Director
Families
<http://www.partnershipforfamilies.org/about-us/staff/>
vfleming@partnershipforfamilies.org
804-353-4264 x101

PCAV

Johanna Schuchert
Executive Director
www.pcav.org
jschuchert@pcav.org
(804) 359-6166 x310

PCAV

Michele Powell
Healthy Families Virginia Director
www.pcav.org
MPowell@pcav.org

PCAV- Families Forward

Chris Spain
Director of Prevention and Public Policy
<https://www.familiesforwardva.org>
CSpain@FamiliesForwardVA.org

PCAV- Families Forward

Laurel Aparicio
Director, Early Impact Virginia
<https://www.familiesforwardva.org>
LAparicio@earlyimpactva.org

PCAV- Families Forward CHIP

Mylinda S. Moore
Director of Training
mmoore@chipofvirginia.org

Peter Paul Child Development Center

Damon Jiggetts
Executive Director
Educate the child, Engage the family and empower the community
www.peterpauldevcenter.org
djiggetts@peterpauldevcenter.org
(804) 780-1195

RBHA: Richmond Behavioral Health Authority

John Lindstrom
Chief Executive Officer
Mental health and Well-being, Behavioral health
www.rbha.org
Community@rbha.org
804-819-4000

RCHD: Richmond City Health District *

Patricia Mills
Director of Health Equity
Housing, Education, Food access, Transportation, Employment, Healthcare access, Health equity
www.vdh.virginia.gov/richmond-city/
charles.lee@vdh.virginia.gov
(804) 205-3722

RCPD: Richmond City Police

Adrienne E. Gardner
Detective Sergeant
Build life skills, Building bonds between Communities & law enforcement, Public safety
www.richmondpal.com
Adrienne.Gardner@richmondgov.com
804-213-6847 cell

RDSS: City of Richmond Dept. of Social Services

Shunda Giles
Director
Health, Housing, Workforce, Nutrition, Economic support & independence, Comprehensive services act, Healthy start
www.richmondgov.com
asksocialservices@richmondgov.com

Rebuilding Together Richmond

RICHMOND, VIRGINIA
TECHNICAL REPORT



Mary Kay Huss
Executive Director
Safe communities & housing
rebuildingtogetherrichmond.org
marykay@rebuildingtogetherrichmond.org
804 447 3841

Reestablish Richmond

Katie Ayers
Executive Director
<http://www.reestablishrichmond.org>
kate@reestablishrichmond.org

Replenish Richmond

Richard S. (Rick) Tatnall
Executive Director
Sex trafficking
<http://replenishrichmond.com/virginia-takes-the-lead/>
rick@replenishrichmond.com
(804) 325-3674

Richmond Academy of Medicine

James G. Beckner
Executive Director
jbeckner@ramdocs.org

Richmond Behavioral Authority

Amy Erb
Director of Regional Programs
Behavioral health/Drug abuse
www.rbha.org
erba@rbha.org
804-819-4000

Richmond Behavioral Health Authority

Charlene Edwards
Behavioral health
www.rbha.org
804-819-4000

Richmond Behavioral Health Authority

Dr. James C. May
Director of Planning and Development
Behavioral health
www.rbha.org
804-819-4000

Richmond Behavioral Health Authority

Charlene Edwards
Suicide prevention
www.rbha.org
(804) 819 4068

Richmond City Givers

Providing funding for worthy programs and organizations serving our community
<http://www.rivercitygivers.com/>
rivercitygivers@gmail.com

Richmond City Parks & Recreation

Robert Steidel
Deputy Chief Administrative Officer for Operations
Before & after school programs, Cemeteries, Cultural arts, Outdoor education, Recreation
<http://www.richmondgov.com/Parks/index.aspx>
AskParkRec@richmondgov.com
(804) 646-5733

Richmond Community Church

Rick McDaniel
Senior Pastor
Faith
<http://rcc-impact.com>
pastorrick@rcc-impact.com
804-364-5000

Richmond Family and Fatherhood Initiative

Anthony J. Mingo, Sr.
Program Coordinator
Family
www.virginiafamilies.org
(804)205-3717

Richmond Food Justice Alliance

Access to healthy food
<https://www.facebook.com/RVAFoodJustice/>
oalqadaffi@gmail.com

Richmond Health District

Deanna Krautner
Population Health Manager
deanna.krautner@vdh.virginia.gov
(804) 652-3190

RICHMOND, VIRGINIA
TECHNICAL REPORT



Richmond Hill

Joel T. Blunk
Co Pastorial Director
Prayer, Hospitality, Racial reconciliation and
spiritual development
www.richmondhillva.org
jblunk@richmondhillva.org
1-804-783-7903

Richmond Justice Initiative (RJI)

Jessica Willis
CEO
Sex trafficking
<http://richmondjusticeinitiative.com/about-us/our-mission/>
jessica@rvaji.com
804-781-4567

Richmond Justice Initiative (RJI)

Joell (Maisano) Denison
Director of Programs and Training
Sex trafficking
www.rvaji.com
joell@prevention-project.org
804-781-4567

Richmond Juvenile Detention Center

Acting Superintendent
Leeta.Jones@richmondgov.com

RMHF: Richmond Memorial Health Foundation

M. Gabriela Alcalde, MPH, DrPH
Managing Director for Equity and Health
www.rmhfoundation.org/
galcalde@rmhfoundation.org
804-282-6282

Richmond Peace Education Center

Conflict resolution, Youth programs, Racial
justice, Global peace
www.rpec.org/
rpec@rpec.org

Richmond Police Chief

Alfred Durham
Police Chief

<http://www.richmondgov.com/Police/index.aspx>
policemediarelations@richmondgov.com
(804) 646-6842

Richmond Region Tourism

Matt Robinette
Director of Convention & Sports Services
Inclusiveness, Service, Integrity, Historical sites
<https://www.visitrichmondva.com/partners/events/richmond-region-tourism-events/>
mrobinette@VisitRichmondVA.com
(804) 783-7450

Richmond VA Medical Center: Hunter Holmes McGuire

Laura Pond, LCSW Suicide Prevention Coordinator
Suicide Prevention Coordinator
Health/Suicide prevention
<https://www.richmond.va.gov/features/Richmond.asp>
Laura.Pond@va.gov
804-675-5000 ext. 4554

RISC: Richmonders Involved to Strengthen our Communities

Housing, Health Care, Employment, School
Atte
www.riscrichmond.org/
riscoffice@gmail.com
804-476-0889

Rise for Youth

Valerie Slater
Ex. Director
valerie@riseforyouth.org

RMHF: Richmond Memorial Health Foundation

Mark D. Constantine
President and CEO
Access to health care, Equity & health, Impact
investing, Invest health RVA, Relationships,
Collaborations
<https://www.rmhfoundation.org/>
mconstantine@rmhfoundation.org
(804) 282-6282

Robins Foundation

Elliot Haspel
Program Officer
Investing in programs that enrich the whole family (and whole neighborhoods) in order to alter intergenerational poverty in greater Richmond's emerging neighborhoods.
www.robinsfdn.org
elliott.haspel@robinsfdn.org

ROI: Richmond Opportunities Incorporated

Community engagement and communication, Holistic coaching and coordinated case management and service network, Data evaluation and communications to align community resources
http://rvaopportunities.org/
esummerfield@rvaopportunities.org
804-357-4799

Ronald McDonald House of Charities

Kerry Blumberg
Executive Director
kerry@rmhc-richmond.org

Rotary Club

Kelly Keene
President
Education, Health, Communities, Disease prevention, Clean water initiatives, Promotes Peace
http://www.rotaryclubofrichmond.org
http://www.rotaryclubofrichmond.org/contact/

RPEC: Richmond Peace Education Center

Adria Scharf
Executive Director
Equal economic & political power, Safety, Nonviolence, Diversity, Education, Social justice
www.rpec.org/
scharf@rpec.org

RPN: Richmond Promise Neighborhood Family Engagement – Promise Family Network Community outreach and

engagement events Action teams & service partnerships promise academy
https://www.peterpauldevcenter.org/our-programs/community-support-programs/promise-neighborhood/
gcreighton@peterpauldevcenter.org

RPS: Richmond Public Schools

Jason Kamras
Superintendent
Education
www.rvaschools.net
jkamras@rvaschools.net

RRHA: Richmond Redevelopment & Housing Authority

Robert J. Adams
Commissioner
Housing, Community development
https://www.rrha.com/
info@rrha.com
804-780-4246

RVA Food Collaborative

Food access
https://www.facebook.com/rvafoodcollaborative

RWJ: Robert Wood Johnson Foundation

Rich Besser
President
Health leadership; Health systems; Healthy communities; and Healthy kids, healthy weight.
https://www.rwjf.org/
rbesser@rwjf.org
(877) 843-7953

Sacred Heart Center

Tanya Gonzalez
Executive Director
Adult education, 1st generation American success, Hub to support, celebrate culture, and facilitate access for the Latino community.
https://shcrichmond.org/en/
tanya_gonzalez@shcrichmond.org
804-230-4399

Safe Harbor

RICHMOND, VIRGINIA
TECHNICAL REPORT



Cathy Easter
Executive Director
Domestic and/or sexual violence, Human trafficking, Community outreach, Education, Prevention services
safeharborshelter.com/
cathy@safeharborshelter.com
804-249-9470 x 11

Safe Kids Virginia

Corri Miller-Hobbs
<https://www.safekids.org/coalition/safe-kids-virginia>
corri.millerhobbs@vcuhealth.org
804-628-2077

Saint Paul's Baptist Church

Dr. Lance D. Watson
Pastor
Faith
<https://www.myspbc.org>
pastor@myspbc.org
(804)643-4000

**Salvation Army Central Virginia
Family Services, Homeless Preventions,
Community Education, Worship Services,
Shelters**

[virginiasalvationarmy.org/richmondva/
@CentralVASalvationArmy](http://virginiasalvationarmy.org/richmondva/@CentralVASalvationArmy)
(804) 225-747
Smart beginnings Greater Richmond,
Service delivery, Systems change, Stronger
communication in provider community, Bridge
between schools, Localities and programs
smartbeginningsrva.org/
admin@smartbeginningsrva.org

Sports Backers

Engage underserved populations, Build innovative culture, Diversify funding sources
<https://www.sportsbackers.org/>
info@sportsbackers.org

The Community Builders, Inc.

Youth development, Education, Workforce development, Asset building, Community engagement, Real estate
www.tcbinc.org

<http://www.tcbinc.org/contact.html>

The Community Foundation Serving Richmond & Central Virginia

Sherrie Armstrong
President/CEO
Hunger prevention
www.cfrichmond.org
sbarmstrong@cfrichmond.org
(804) 409-5601

The Greater Richmond ARC

Penni Sweetenburg-Lee
INFO@RICHMONDARC.ORG

The Office of Community Wealth

Reggie Glover
Reginald.Gordon@RichmondGov.com

The Office of Community Wealth

Valaryee Mitchellin
Valaryee.Mitchell@RichmondGov.com

The Virginia Homeless Solutions Program (VHSP)

Nichele Carver
Program Contact
Homelessness
<http://www.dhcd.virginia.gov/index.php/housing-programs-and-assistance/homeless-prevention-and-assistance-services/homeless-prevention-and-assistance-programs/virginia-homeless-solutions-program.html>
hsnh@dhcd.virginia.gov
804-371-7113

Trauma-Focused Treatment

Lisa Wright
Program Coordinator
lwright@grscan.com

UMFS

Foster Care & Adoption, Residential Treatment, Community-Based Services, Specialized/Therapeutic Education
<https://www.umfs.org/>
info@umfs.org

RICHMOND, VIRGINIA
TECHNICAL REPORT



UnboundRVA
Entrepreneurship
www.unboundrva.org/
info@unboundrva.org

United Methodist Family Service
Denise Purgold
Foster care/Adoption
dpurgold@umfs.org

**United Way Of Greater Richmond
Community Impact, Volunteerism, Re-
search, Local Leadership**
[https://www.yourunitedway.org/
customerservice@yourunitedway.org](https://www.yourunitedway.org/customer-service@yourunitedway.org)

**VCU Partnership for People with Disabili-
ties**
Molly Dellinger Wray
Program Specialist/Community Supports for
Positive Behavior supports and abuse and ne-
glect
MDWRAY@VCU.EDU

**VCU Douglas Wilder School of Govern-
ment and Public Affairs**
ROBYN DIEHL MCDOUGLE
Associate Professor and Director, Center for
Public Policy
[https://wilder.vcu.edu/about/
rdmcdougles@vcu.edu](https://wilder.vcu.edu/about/rdmcdougles@vcu.edu)

**VCU Douglas Wilder School of Govern-
ment and Public Affairs**
JOHN ACCORDINO
Professor
Commercial and neighborhood revitalization
methods; Impacts of community revitalization
policies; Comparative (U.S. and European) ur-
ban revitalization policies; Planning for Impact:
Richmond takes an aggressive approach to tar-
geting neighborhood revitalization resources.
Practicing Planner, Vol. 3, No. 1 (March 2005).
[https://wilder.vcu.edu/about/
jaccordi@vcu.edu](https://wilder.vcu.edu/about/jaccordi@vcu.edu)

**VCU Douglas Wilder School of Govern-
ment and Public Affairs**
KATHRYN HOWELL

Assistant Professor
Affordable housing; Community development;
Gentrification
[https://wilder.vcu.edu/about/
klhowell@vcu.edu](https://wilder.vcu.edu/about/klhowell@vcu.edu)

**VCU Douglas Wilder School of Govern-
ment and Public Affairs**
MARY MOORE
Senior Research Director, Survey and Evalua-
tion Research laboratory
Public policy; Survey research; Program evalua-
tion
[https://wilder.vcu.edu/about/
mmoore@vcu.edu](https://wilder.vcu.edu/about/mmoore@vcu.edu)

**VCU Douglas Wilder School of Govern-
ment and Public Affairs**
JENNIFER REID
Senior research associate
Program evaluation; Survey research methods;
Project management
[https://wilder.vcu.edu/about/
jguyre@vcu.edu](https://wilder.vcu.edu/about/jguyre@vcu.edu)

VCU School of Social Work
Jamie Cage
Assistant professor
The overarching goal of her research is to con-
tribute to the optimal development and overall
well-being of maltreated youth involved with
the child welfare system by developing studies
that influence child welfare policy and practice.
She is also interested in understanding the risk
and protective factors of psychosocial develop-
ment for maltreated youth, with the ultimate
purpose of creating and implementing inter-
ventions that will foster optimal development
and empower child welfare involved youth to
reach their aspirations and full potential.
[https://www.socialwork.vcu.edu
jlcage@vcu.edu](https://www.socialwork.vcu.edu/jlcage@vcu.edu)

VCU School of Social Work
Kim Flournoy DiJoseph
Director of student success and associate pro-
fessor in teaching
Kim Flournoy DiJoseph is the director of stu-
dent success and associate professor in

teaching. DiJoseph brings clinical practice, course development, teaching, and advocacy experience with an emphasis on intersectionality and the contextual continuum of violence on children and families. Her trauma-informed consultant work focused on the development of strategies and facilitation of processes to achieve meaningful organizational culture change.

<https://www.socialwork.vcu.edu>
kfdijoseph@vcu.edu

VCU School of Social Work

Daryl V. Fraser

Associate professor in teaching

Daryl Fraser is a licensed clinical social worker and an associate professor in teaching at the VCU School of Social Work. He holds a B.S. in Psychology and a Masters of Social Work from VCU with practice experience that spans the areas of mental health, substance abuse, child welfare, and HIV/AIDS. Daryl values transformative, student-centered learning, particularly in community-engaged learning spaces. As an instructor in the Office of Field Education, he strives to support BSW and MSW students in connecting theory and practice skills learned in their social work coursework to their real-world/hands-on experiences at their internships, hoping to contribute to their development as competent and culturally sensitive social work practitioners.

<https://www.socialwork.vcu.edu>
fraserdv@vcu.edu

VCU School of Social Work

Hyojin Im, Ph.D.

Assistant professor

Hyojin Im, Ph.D., is interested in promoting mental health and psychosocial support for refugee and immigrant communities, both local and international, by building community capacity and partnership for culturally-responsive services and trauma-informed care. She is also passionate about linking local and global practices and policies for seamless refugee programs and sustainable interventions.

<https://www.socialwork.vcu.edu>

him@vcu.edu

VCU School of Social Work

<https://www.socialwork.vcu.edu>

VCU School of Social Work

Muthoni Imungi, Ph.D.

Director of field education and associate professor in teaching.

Muthoni Imungi is the director of field education for the VCU School of Social Work. She is responsible for managing the Office of Field Education, which oversees the field education of approximately 600 BSW and MSW students each year. BSW and MSW students complete their field education in agencies and organizations throughout the Commonwealth of Virginia. Annually, the Office of Field Education partners with approximately 450 social workers, who supervise the field education of all VCU BSW and MSW students.

<https://www.socialwork.vcu.edu>
mimungi@vcu.edu

VCU School of Social Work

Stevara Clark Johnson

Assistant professor in teaching

of educational products; evaluating curriculum and training programs for effectiveness for youth in foster care; developing and delivering curriculum focused on social and independent living skills for students with intellectual disabilities.

<https://www.socialwork.vcu.edu>
scjohnson2@vcu.edu

VCU School of Social Work

Abbie D. Kinnebrew, LCSW

Associate professor in teaching

Kinnebrew has been an active member of the Greater Richmond Trauma-Informed Community Network (TICN) since 2013. She co-founded the Trauma-Informed Workforce Development Committee (TIWD) of the TICN, which works to influence the education, training, and certification of our current and future child-serving workforce in the Greater Richmond area.

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kinnebrewad@vcu.edu

VCU School of Social Work

Hollee A. McGinnis, Ph.D.

Assistant professor

Hollee A. McGinnis is an assistant professor in the VCU School of Social Work. She is interested in children's mental health and well-being, child welfare and alternative care systems, and global social work. Her research broadly examines the social and cultural determinants of children's mental health and well-being, with a specific focus on improving the outcomes of children with histories of early childhood adversity and child welfare involvement in the U.S. and globally. This research is informed by her post-MSW training in children's mental health at the Yale Child Study Center, work as the policy director at the Donaldson Adoption Institute, and founder of the non-profit organization for adult intercountry adoptees and adoptive families, Also-Known-As, Inc.

<https://www.socialwork.vcu.edu>

hamcginnis@vcu.edu

VCU School of Social Work

Nicole L. O-Pries, LCSW

Assistant professor in teaching

O-Pries is currently an assistant professor at Virginia Commonwealth University's School of Social Work, where she teaches courses focused on trauma-informed and trauma-focused social work practice, clinical practice, and social justice. Her service work includes active membership in the Greater Richmond Trauma-Informed Community Network, as well as being a program advisory member of the Children's Mental Health Network and advising local nonprofits regarding integration of trauma-informed care principles.

<https://www.socialwork.vcu.edu>

nlopries@vcu.edu

VCU School of Social Work

Dr. Alex Wagaman

Facilitator

mawagaman@vcu.edu

Virginia Anti-Violence Project

Community, Family/Healthy Relationships & Sexuality, Intersectionality/Racial Justice, LGBTQ Liberation/Equity, Trust/Accessibility, Creativity, Integrity and Transparency

<https://virginiaavp.org/>

director@virginiaavp.org

Virginia Board for People with Disabilities

Disability Services

Heidi L. Lawyer

Executive Director

Disability Services

<https://www.vaboard.org/>

Heidi.Lawyer@vbpd.virginia.gov

(804) 786-9369

Virginia Board for People with Disabilities

Disability Services

Penni Sweetenburg-Lee

Director of Training Programs

Disability Services

Penni.Sweetenburg-Lee@vbpd.virginia.gov

(804) 786-9381

Virginia Commonwealth University

Dr. Michel B. Aboutanos

Director

Injury and violence prevention

<https://medschool.vcu.edu/expertise/detail.html?ID=632>

michel.aboutanos@vcuhealth.org

(804) 827-2409

Virginia Commonwealth University

Nan McKenney

Child Abuse Prevention/Treatment

<https://www.chrichmond.org/Provider-Directory/Barrows-Compton.Caroline.htm>

caroline.barrowscompton@vcuhealth.org

Virginia Community Healthcare Association

Neal Graham

Executive Director

Health prevention; Rural care; Community providers

NGraham@VaCommunityHealth.org

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Virginia Department of Health
Richmond, VA
Infant and Child Death Projects Coordinator
<http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/infant-and-child-mortality-surveillance-system/contact/>
allison.clevenger@vdh.virginia.gov
804-205-3854

Virginia Department of Health
Anya Shaffer
Coordinator
Violence and suicide prevention
Anya.Shaffer@vdh.virginia.gov

Virginia Department of Health, Office of the Chief Medical Examiner
Mealnie Rouse
Maternal Mortality Projects Coordinator
Maternal Mortality
<http://www.vdh.virginia.gov/medical-examiner/fatality-review-surveillance-programs-reports/maternal-mortality-review-team/>
Melanie.Rouse@vdh.virginia.gov
(804) 205-3857

Virginia Early Childhood Foundation
Karin Bowles
Director of Strategy
karin@vecf.org

Virginia Early Childhood Foundation
Amy Hatheway
Vice President of Community Networks
amy@vecf.org

Virginia Early Childhood Foundation
Generic email
Smart beginnings, Virginia quality service & care, Data & policy integrity.
www.vecf.org/
info@vecf.org

**Virginia Family and Fatherhood Initiative
Richmond Health District**
Anthony J. Mingo, Sr.
Program Coordinator,

Youth and Family
<https://virginiafamilies.org/>
<https://virginiafamilies.org/contact>
(804)205-3717

Virginia Health Care Foundation
Denise Konrad
Director of Strategic Initiatives & Policy
<https://www.vhcf.org/about/>
DKonrad@vhcf.org

Virginia Heroes Incorporated
Joyce Cole Johnson
Program Director for Volunteer Mentoring Opportunities
Character development, Violence prevention and financial literacy
www.virginiaheroesinc.org
jajadst@aol.com

Voices for Children
Chloe Edwards
Outreach Coordinator
www.vakids.org
Chloe@vakids.org

Voices for Children
Allison Gilbreath
Policy analyst
www.vakids.org
allison@vakids.org

Voices for Children
Beth Nolan
Kids Count Director
www.vakids.org
beth@vakids.org
804-649-0184 ext. 104

Community Prevention Services

Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
Nurse Family Partnership				
Nurse Family Partnership Western Tidewater Health District NFP Program	https://www.nursefamilypartnership.org/locations/virginia/			
Triple P Parenting				
http://www.chesterfield.gov/parenting/ Note: Richmond is independent, not in county	https://www.tripleparenting.com/us/triple-p/	National organization with a training chapter in Richmond		
Safe to Sleep Campaign				
Safe Sleep for Babies / Safe Sleep 365	http://dss.virginia.gov/safe_sleep/ https://dss.virginia.gov/family/safe_sleep.cgi	Statewide	Outreach organization. Provide materials and education but not direct service	
Parent-Child Interaction Therapy				
Partners in Parenting	https://www.piprva.com/	Richmond, VA		
Community-based Substance Abuse Treatment Programs				
Family Counseling Center for Recovery	https://fccr-va.com/	Richmond, Midlothian, Fredricksburg		
Family Counseling Center for Recovery Southlake Addiction treatment for women Addiction treatment for men Court ordered alcohol treatment for DUI/DWI offenders Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/family-counseling-center-for-recovery-southlake	Richmond, Midlothian, Fredricksburg		

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Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
Family Counseling Center for Recovery Adolescents (teen) addiction treatment Dual diagnosis treatment (Persons with co-occurring mental and substance abuse disorders) Addiction treatment for pregnant/postpartum women Addiction treatment for women Addiction treatment for men Court ordered alcohol treatment for DUI/DWI offenders ASL or other assistance for hearing impaired Outpatient counseling treatment Inpatient partial hospitalization/day treatment/work programs	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/family-counseling-center-for-recovery-southlake	Richmond, Midlothian, Fredricksburg		
Human Resources Inc Outpatient Methadone Program Addiction treatment for women Addiction treatment for men Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/human-resources-inc-outpatient-methadone-program	Richmond, VA		
McGuire Veterans Affairs Medical Ctr Substance Abuse Treatment Program Dual diagnosis treatment (Persons with co-occurring mental and substance abuse disorders) Aftercare addiction treatment (Halfway houses, sober living facilities) Outpatient counseling treatment Residential long-term inpatient treatment (60, 90, 120 days) Holistic rehabilitation treatment, alternative treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/mcguire-veterans-affairs-medical-ctr-substance-abuse-treatment-program	Richmond, VA		703 Beds available nightly

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Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
Metro Treatment of Virginia LP DBA Richmond Treatment Center Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/metro-treatment-of-virginia-lp-dba-richmond-treatment-center	Richmond, VA		2016 Provided serves to 2,548 individuals through programs
Richmond Behavioral Health Authority Substance Abuse Services Addiction treatment for pregnant/postpartum women Addiction treatment for women Outpatient counseling treatment Holistic rehabilitation treatment, alternative treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/richmond-behavioral-health-authority-substance-abuse-services	Richmond, VA		2016 3,789 Mental Health Services 1,175 Developmental Disability Services 1,469 Substance Use Disorder Services
Richmond IOP PLC Recovery Resources Addiction treatment for women Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/richmond-iop-plc-recovery-resources	Richmond, VA		
Richmond Private Methadone Clinic (RPMC) Addiction treatment for pregnant/postpartum women Addiction treatment for women Addiction treatment for men Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/richmond-private-methadone-clinic-rpmc	Richmond, VA		
Richmond Southside Treatment Center Addiction treatment for Christians Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/richmond-southside-treatment-center	Richmond, VA		
Rubicon Inc Outpatient Services Addiction treatment for persons with HIV/AIDS Addiction treatment for women Court ordered addiction treatment Outpatient counseling treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/rubicon-inc-outpatient-services	Richmond, VA		2017 1,326 lives touched through programs and services 482 careers launched

Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
Virginia Health Center Adolescents (teen) addiction treatment Dual diagnosis treatment (Persons with co-occurring mental and substance abuse disorders) Court ordered addiction treatment Addiction treatment for Christians Outpatient counseling treatment Holistic rehabilitation treatment, alternative treatment	https://www.rehabcenter.net/outpatient-rehab-centers/virginia-outpatient-rehab-centers/richmond/virginia-health-center	Richmond, VA		
Healthy Start Program, Enhanced Model				
Richmond Healthy Start Initiative 400 East Cary Street Richmond City Health Dept Building Richmond, VA 23219 804-205-3684	http://www.richmondgov.com/SocialServices/HealthyStartInitiative.aspx	City of Richmond		
Partnership for Families		City of Richmond		2016 Monthly classes 526/mo 89 children in childcare program 406 annually access multiple programs
Loving Steps Healthy Start 109 Governor Street 8th Floor Richmond, VA 23219 804-864-7764	http://www.vdh.virginia.gov	City of Richmond		2017 57 Head Start programs 12,197 Head Start Slots 27 Early Start Programs 2,386 Early Start Slots
Child safety / injury prevention programs/campaigns				
Safe Kids - Division of VCU Health/Children's Hospital		Central Virginia	Outreach organization doesn't provide direct service	Health Fairs and Carseat giveaways to 400+ families 2x year
Virginia Department of Health YOUTH VIOLENCE PREVENTION PROGRAM	http://www.vdh.virginia.gov/richmond-city/youth-violence-prevention-program/		Outreach organization doesn't provide direct service	

Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
Respite care for foster children and/or disabled children				
Greater Richmond ARC	https://www.richmondarc.org/	Metro Richmond Area		2017 1,335 Children and Adults 270 Pediatric Therapies 397 Children and Adults in Overnight Camp 2016 1304 Children and Adults 536 Infant and Child Development Services 376 Overnight Camp 89 After school programs 2015 1278 Children and Adults 471 Infant and Child Development Services 90 After school programs 402 Overnight Camp
Northern Virginia Family Service	https://www.nvfs.org/assistance/therapeutic-respite-care/			2017 62 Children were in foster care homes
Richmond Department of Social Services	http://www.richmondgov.com/SocialServices/FosterCare.aspx	https://consideringadoption.com/adoptions-by-state/how-to-adopt-in-virginia/richmond-adoption-foster-care-resources		
Homeless Support				
Commonwealth Catholic Charities		Richmond		2016 4,525 individuals received assistance with housing

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Provider	Provider URL	Eligible Geography	Number of Slots Available per Year	Number of Slots Utilized over Past Three Years
CARITAS	http://caritasva.org/	City of Richmond		2017 On average 202 individuals receive shelter each night
HomeAgain	http://homeagainrichmond.org/	City of Richmond		2014 354 families were served
Pilgrims Passage	www.pilgrims-passage.com	City of Richmond		
St. Joseph's Villa 8000 Brook Road Richmond, VA 23227 (804)553-3200		City of Richmond		

Psychographic Data

Experian’s Mosaic USA product segments US households into 19 overarching groups and 71 unique types of consumers and puts 300+ data points into each segment to provide a meaningful view of consumer choices, preferences and habits. Market segmentation data includes socio-demographics, lifestyles, behaviors, and culture using a common customer language to define, engage and measure target audiences. This information can be used to optimize prevention messaging, community engagement strategy, and selection of incentives.

In this case, the 1000 by 1000 square foot cells were evaluated for the dominant household type present in each grid cell. Then the main household types were identified by risk quintile. Since the 1000 by 1000-foot squares covered the entirety of the city, there are a number of empty values. These completely empty squares are usually found on highways, parks or bodies of water and were excluded from analysis.

Of note, in Richmond City the population demographics vary significantly from national averages. According to the United States Census Bureau, in 2017, 48.2% of the population is African American, 44.7% are White, 6.5% are Hispanic or Latino, 3.5% are two or more races, and 2.1% are Asian.

According to this analysis, the estimated unemployment rate in the highest risk quintile is 6.9%.

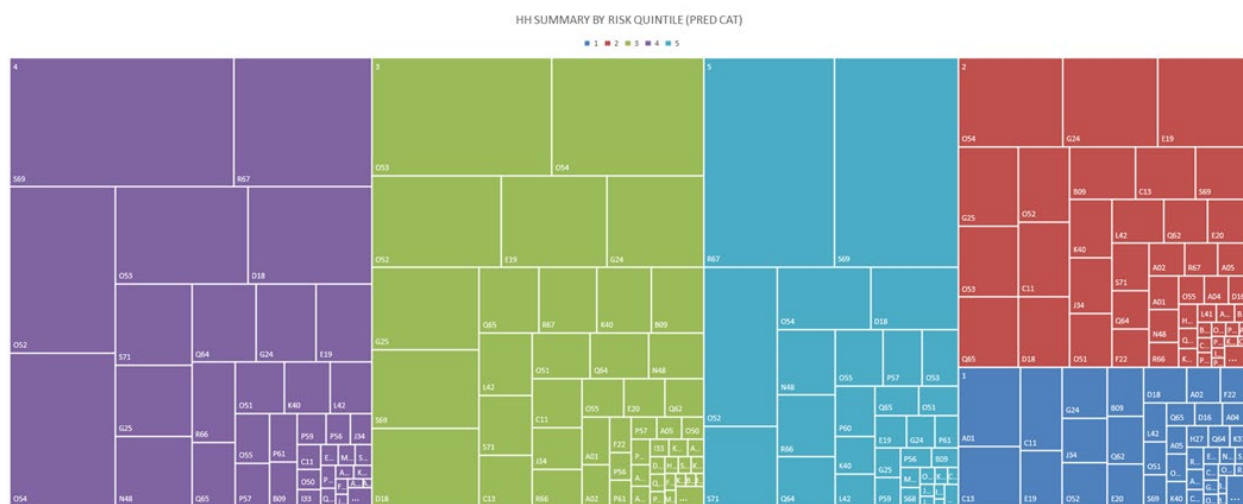


Figure 29

A few items to note:

We included a heatmap in the deliverable named “RISK QUINTILE SUMMARY” which is broken down by Pred_Cat. The larger shapes represent the more dominant profiles and the smaller represent the less dominant profiles.

Richmond Dominant Market Segment by Grid Cell

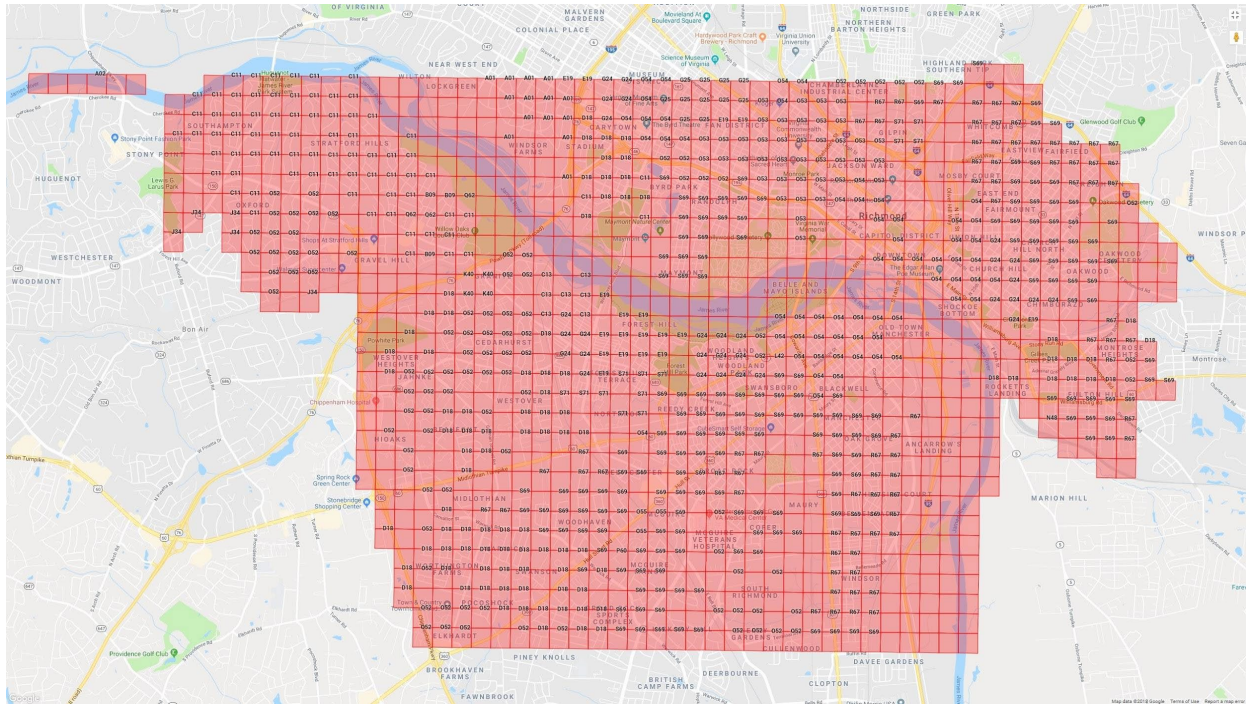


Figure 30

Richmond Mosaic Profiles (in Descending Order of Frequency)

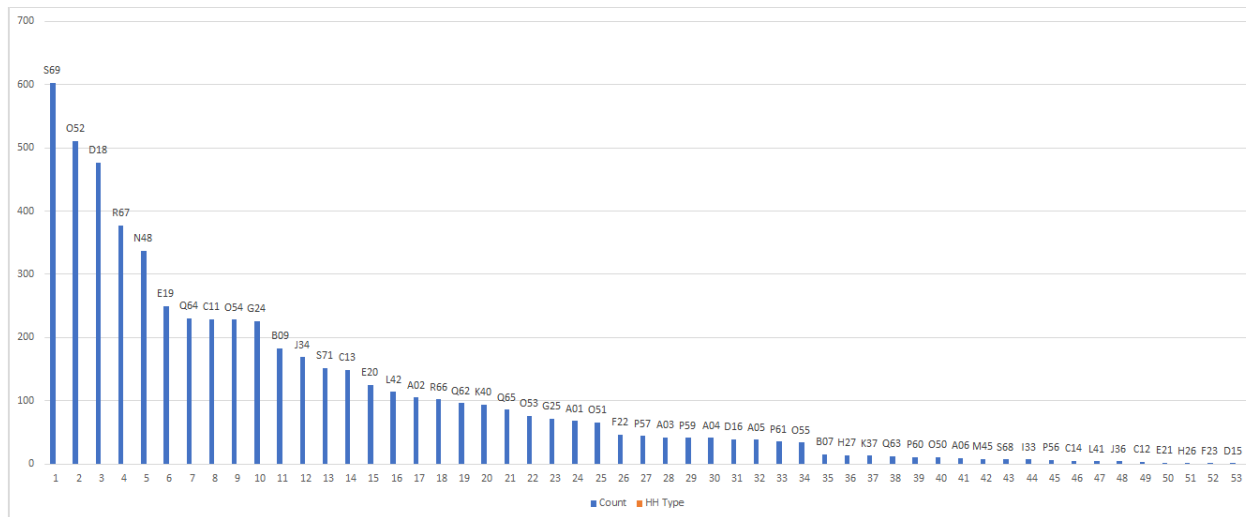


Figure 31

S69: Urban Survivors



Figure 32

Transportation

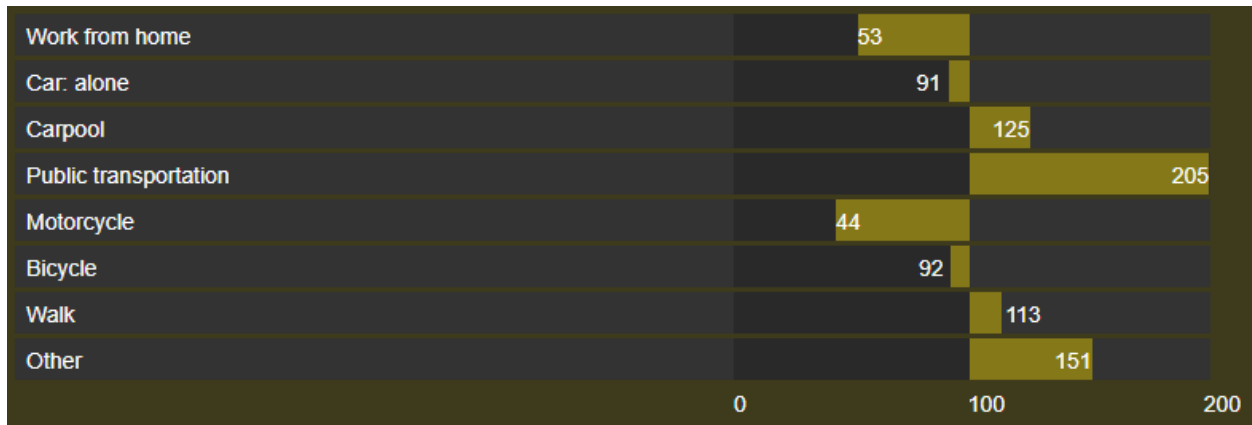


Figure 33

Other: 1.51 times more likely to use paid services such as Uber or Lyft

Language



Figure 34

Level of Education

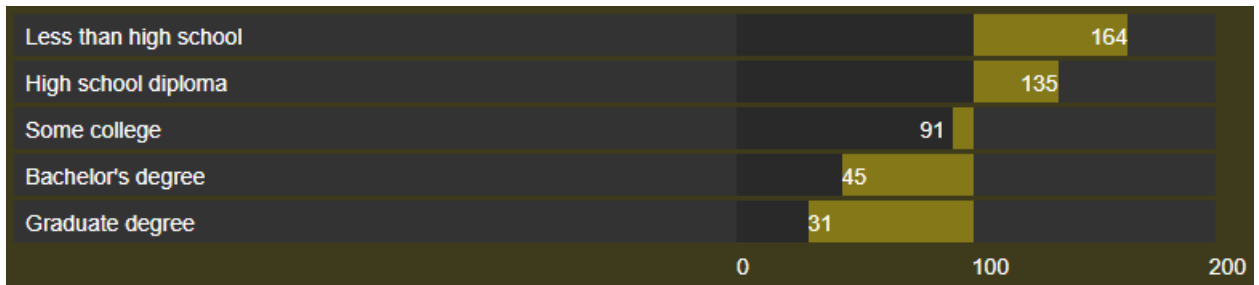


Figure 35

Media Preferences

Communication: Engagement Channel

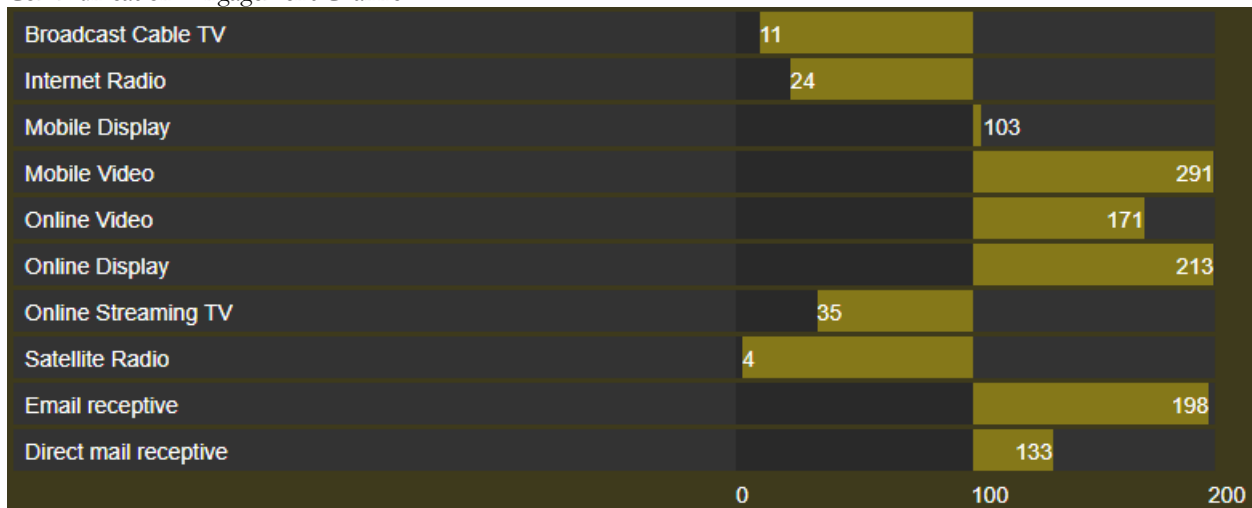


Figure 36



Figure 37

Magazines of Interest



Figure 38

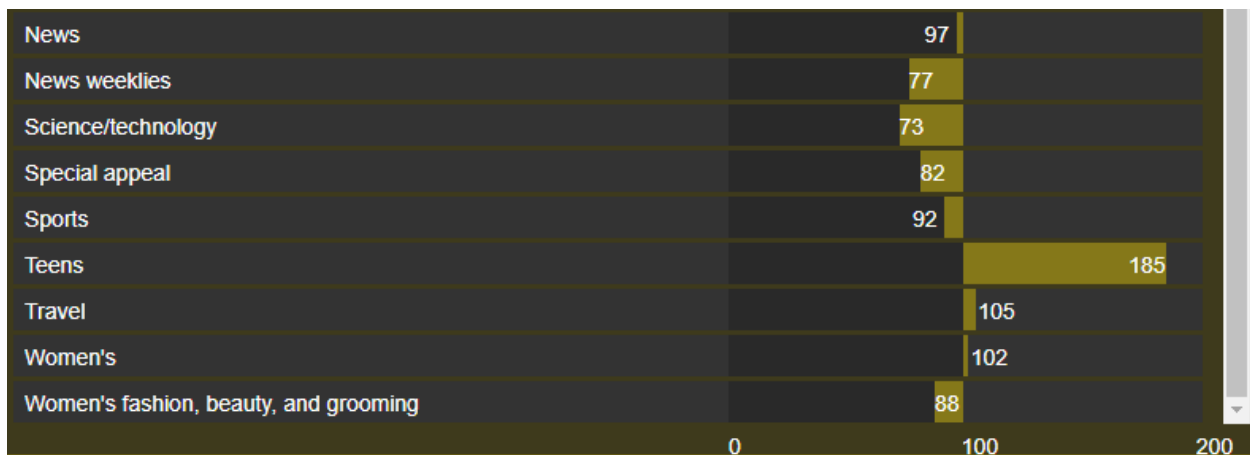


Figure 39

Event Preferences

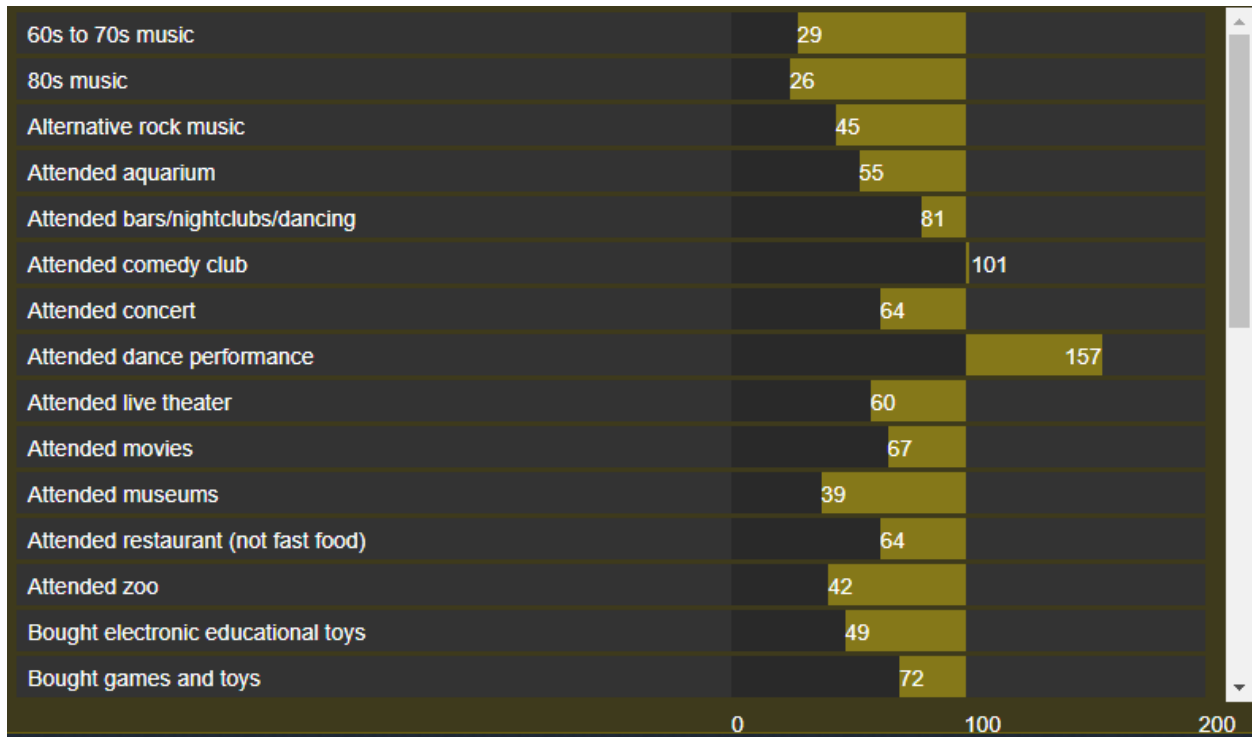
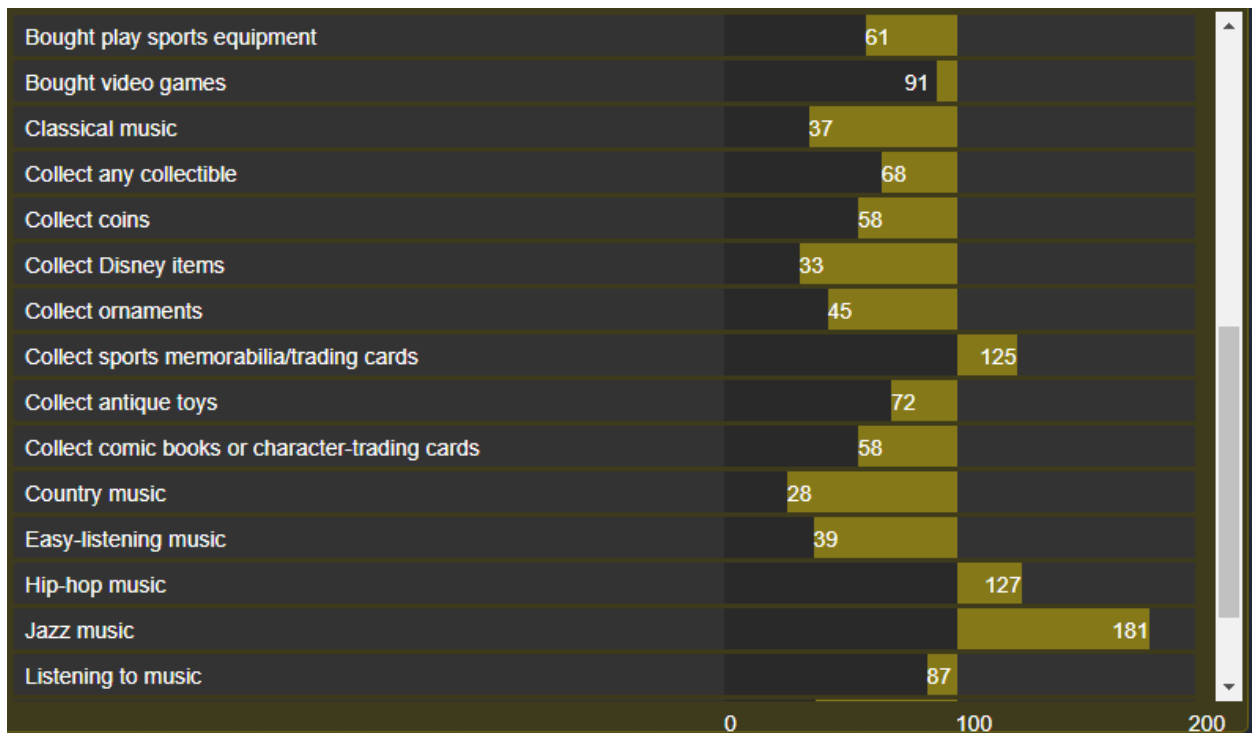


Figure 40



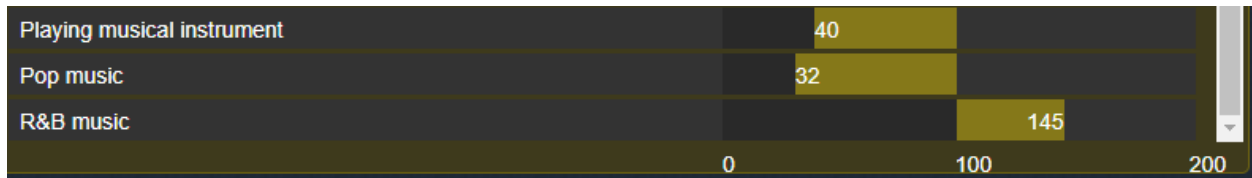


Figure 41

Influencers



Figure 42

Job Skills / Market

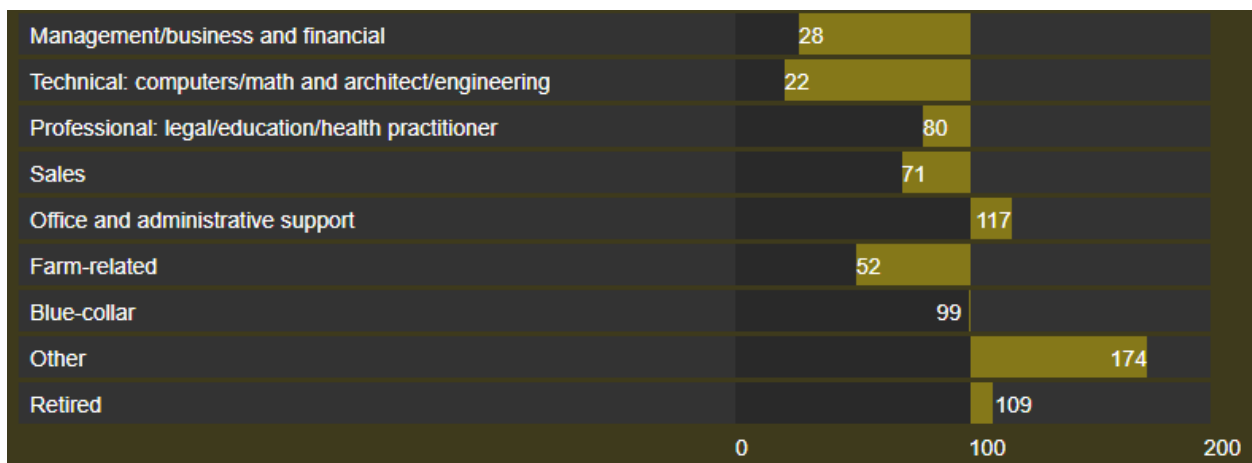


Figure 43

Other: 1.74 times more likely to be non-skilled hourly wage earners

R67: Hope for Tomorrow



Figure 44

Transportation

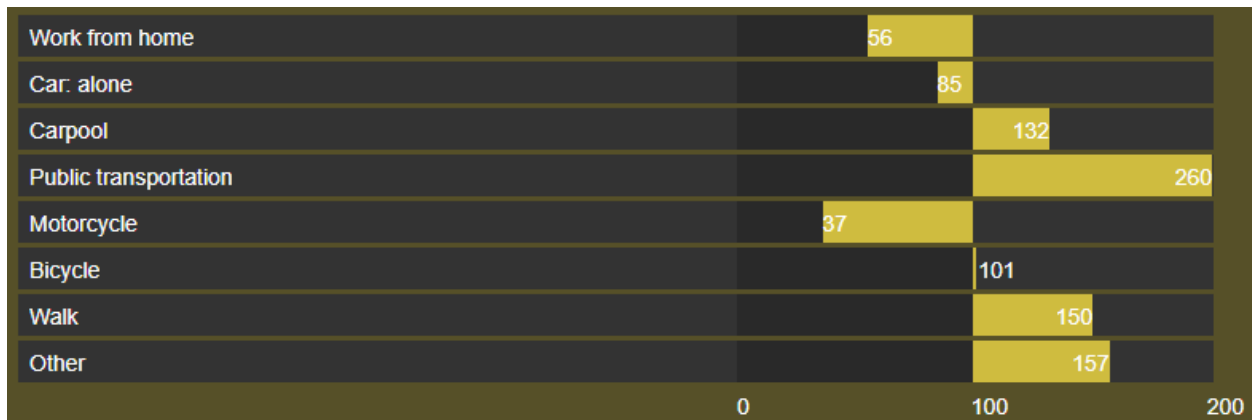


Figure 45

Other: 1.57 times more likely to use paid services such as Uber or Lyft

Language

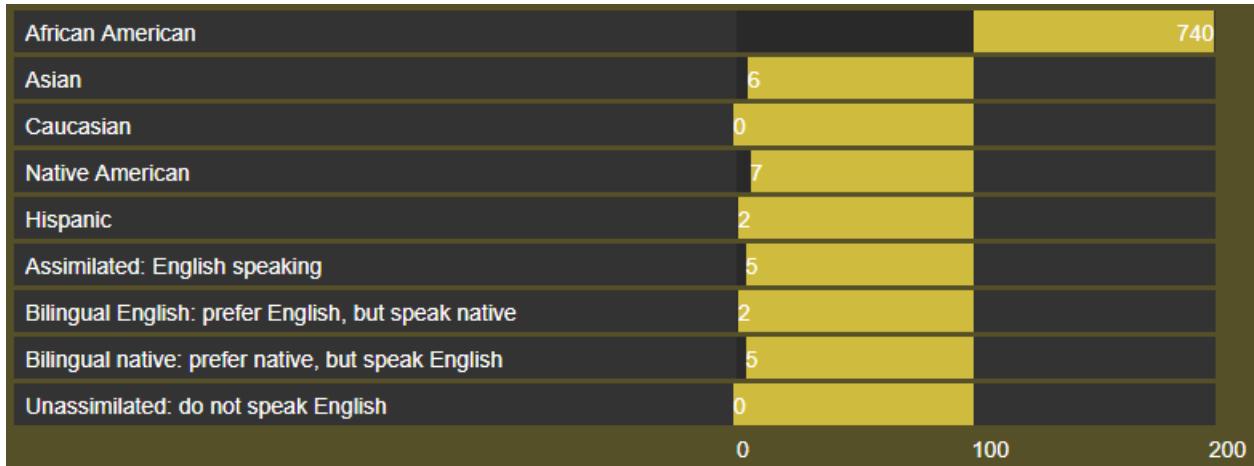


Figure 46

Level of Education

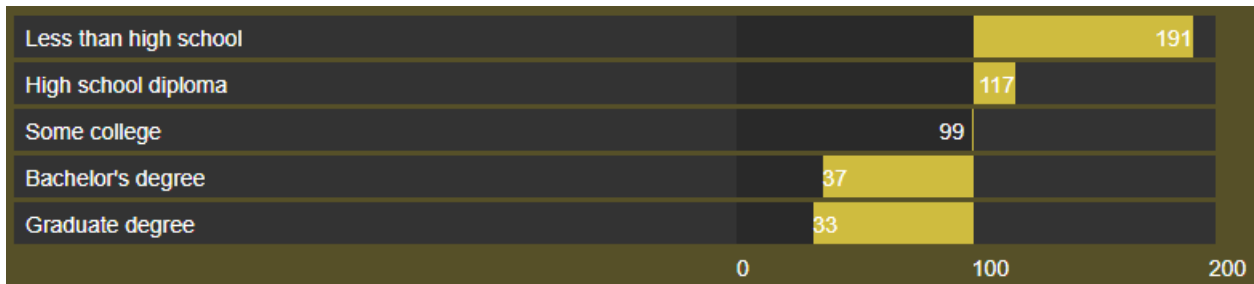


Figure 47

Media Preferences

Communications Engagement Channel

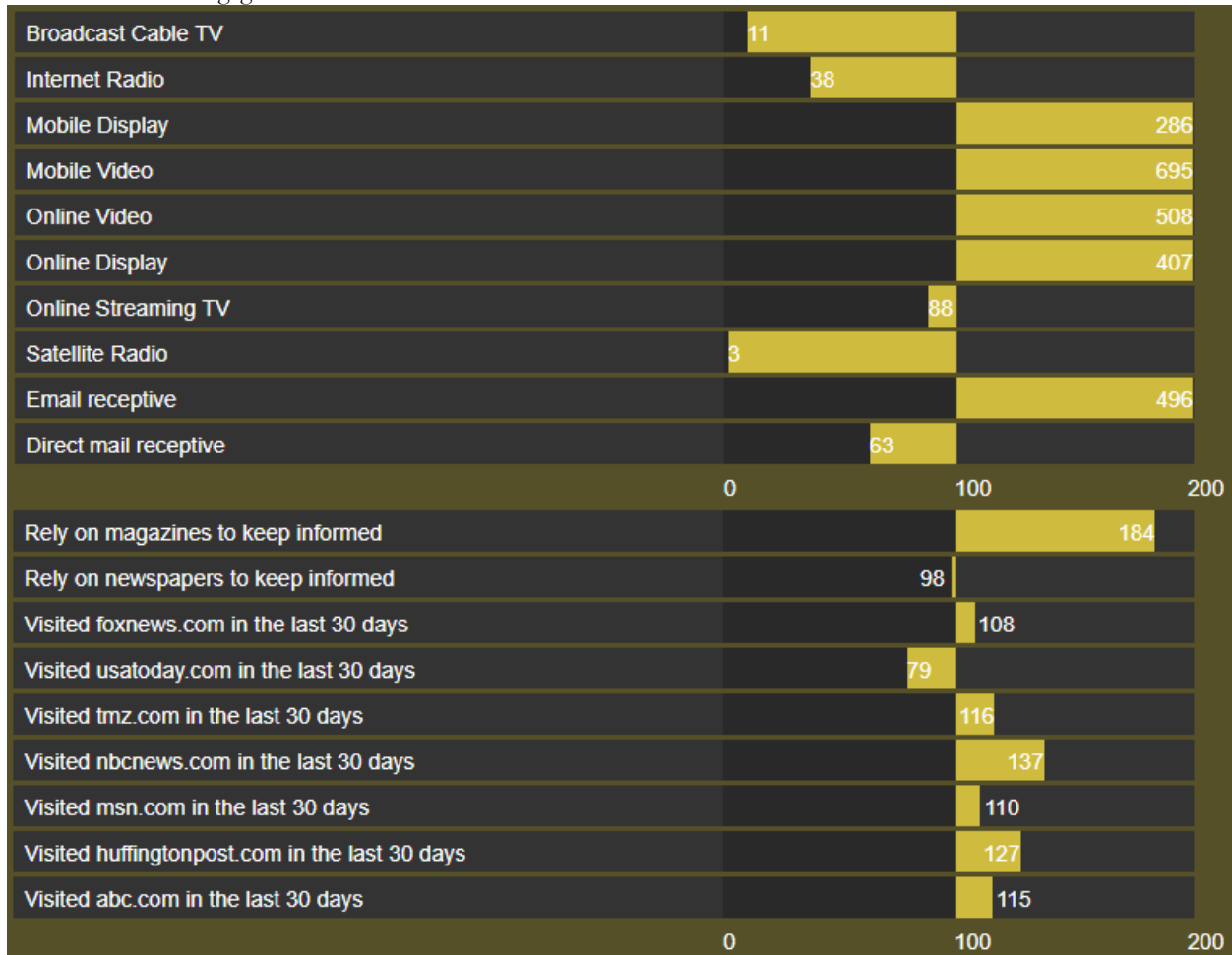


Figure 48

Magazines of Interest

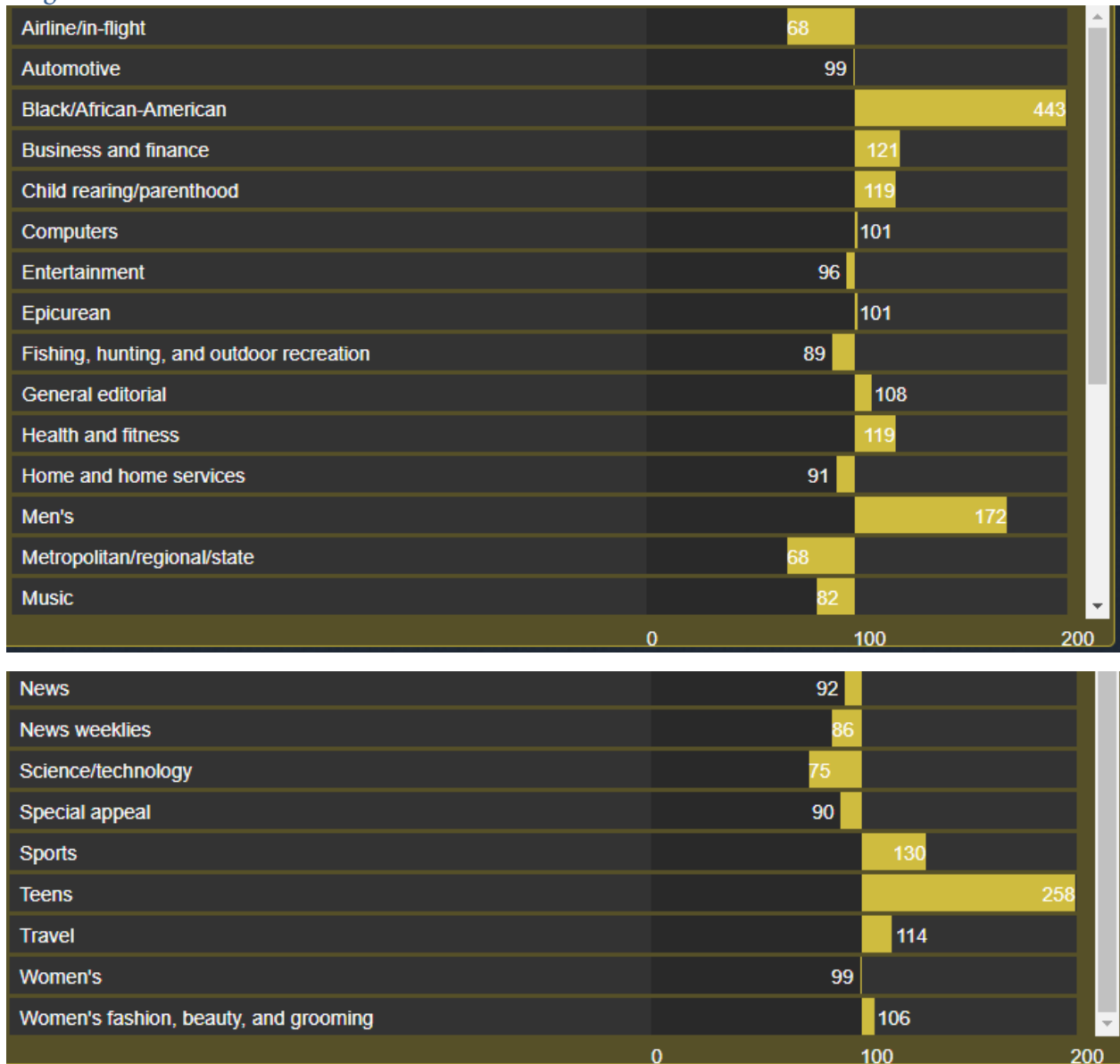


Figure 49

Event Preferences



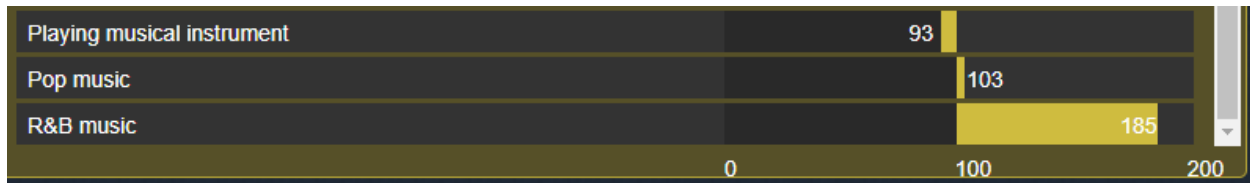


Figure 50

Influencers



Figure 51

Job Skills / Market

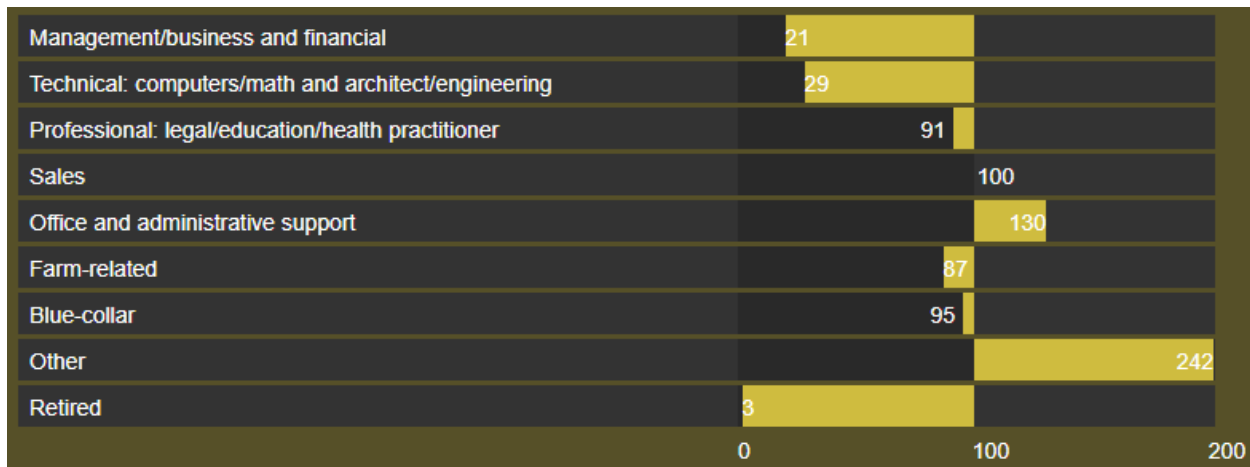


Figure 52

Other: 2.42 times more likely to be non-skilled hourly wage earners

PREVENT

PROGRAM PHASE SUMMARY



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A L I G N
P R E V E N T

PREVENT

Program Phase Summary

Because funding for child maltreatment prevention and related social services is limited or even completely unavailable, our approach aims to leverage existing funding, local expertise, and community-wide participation in prevention activities with objective measures of population health and safety supplying accountability.

Since each community's existing array of programs, services, coalitions, funding sources, policies, and other supports is unique, we do not attempt to "prescribe" specific prevention programs. Moreover, local support for particular programs, some home-grown, is often intense, so we aim first to optimize allocation of existing resources. After 6-12 months have passed, we then reassess population-level health and safety measures to help determine if aligned prevention efforts have "moved the needle" for vulnerable children in places with high spatial maltreatment risk.

An additional reason for avoiding prescriptive recommendations is the relative paucity of data supporting either the effectiveness, replicability, and/or scalability of existing evidence-based child-maltreatment prevention programs. A summary of primary prevention programs that could be effective if funded for both scale and fidelity can be found [here](#).

The purpose of the Prevent phase is to discover the elements of an effective and repeatable combination of prevention resources and supports. After areas with high environmental maltreatment risk have been identified and a strategic plan for targeted allocation of prevention resource is set in motion, we consider development and prioritization of the following:

- Implementation of objectively effective prevention programs and services
- Executive leadership sponsorship of policies supporting evidence-based and evidence-informed practices
- Collaboration among coalitions working to prevent problems having similar risk factors and target populations
- A cross-sector, customer-experience design to engage and sustain positive and efficient relationships with prioritized populations
- An ongoing, continuous quality-improvement feedback cycle to hone ongoing prevention efforts
- Prevention funding to meet capacity needs for essential services

By adopting a national, place-based approach to prevention across multiple jurisdictions, we aim to help communities and governments uncover, evaluate, and replicate effective prevention initiatives. Ultimately, Predict Align Prevent seeks the combination(s) of programs, services, and infrastructure that will reliably prevent child maltreatment and related fatalities.

Risk and Protective Factors: An Interim Report

Data to Foster Dialogues Between Community and Service Providers

Prevent: Richmond, VA

Summary of RISK factors:

According to surveys of populations in high-risk locations, physical safety, exposure to violence, family safety, isolation, and transportation are the primary concerns of Richmond families, and thus geospatial predictors of child maltreatment echo these concerns.

Table 28 - Top Concerns of Richmond Families

Percent of families surveyed	Concerns of Richmond families
93%	of families said they experience stress every day due to concerns related to physical safety.
90%	identified child care as one of the two most important factors in their child's development.
82%	of respondents felt a sense of community isolation (i.e., felt not highly connected).
71%	cited keeping their family safe as a high priority.
71%	of families referenced violence as a daily concern.
51%	of survey respondents indicated that they have no one close by to whom they can turn for help.
47%	identified getting where they need to be as a major concern.

Source: Robins Foundation Survey, October 2017

Geospatial risk predictions identify violent and domestic crimes as among the most important predictors of child maltreatment events in the City of Richmond.

Table 29 - Top 10 Most Predictive Risk Factors, in Order of Importance

Item	Risk
1	The spatial lag of maltreatment
2	Number of simple domestic assaults in a given grid cell
3	Proportion of the population under 18 years old
4	Number of aggravated domestic assaults
5	Population in families

Item	Risk
6	Number of juvenile runaways
7	Neighborhood fixed effect
8	Number of drug and narcotic violations
9	Renter-occupied housing
10	Vacant housing

Among the risk factors listed above, ‘spatial lag’ is the average, nearest-neighbor distance to maltreatment events in the training set, and it accounts for the effect of neighboring maltreatment events on one another. Also, in the above list, the variable ‘neighborhood fixed effect’ indicates the neighborhood in which a particular grid cell is located and controls for neighborhood variation. Finally, ‘nearest neighbor’ risk factors measure the average distance between a maltreatment event and its five closest neighbors. For example, nearest neighbor distance to community centers is the average distance of a maltreatment event’s location from the five community centers closest to it.

Community concerns and risk factors for those crime types correlated with spatial child maltreatment risk overlap in the following ways:

Table 30

CRIMINAL BEHAVIORS:	Aggravated Assault	Domestic Violence	Runaways	Prostitution	Gangs	Robbery	Murder	Drug and Narcotic Violations	Animal Abuse	Animal Aggression
RISK FACTORS: (Ranked by residents of Richmond)										
Community violence- fear of physical safety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Domestic violence in community			✓	✓	✓		✓	✓	✓	✓
Lack of accessibility and availability of child care as it relates to child development		✓		✓			✓	✓		
Juvenile runaways				✓		✓		✓		
Community isolation/lack of social cohesion		✓	✓	✓	✓	✓	✓	✓	✓	
Drug and narcotic violations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of social support		✓	✓	✓			✓	✓		
Lack of transportation		✓		✓				✓		
Vacant housing			✓	✓	✓			✓		
Multiple barriers to being able to provide for family: ranging from nutrition, income stability, and job opportunities		✓	✓	✓	✓	✓		✓		
Large household size							✓	✓		
Lack of availability and accessibility to youth development opportunities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Ann Kearney, EdD

Summary of PROTECTIVE Features

During the Align phase, we identified the optimal locations for prevention resource allocation, including the following:

- | | |
|---|-----------------------------------|
| Shalom Baptist Fellowship Church | North Avenue Branch Library |
| Sixth Mount Zion Baptist Church | East End Branch Library |
| Ebenezer Baptist Church | Hull Street Branch Library |
| Fairfield Court Community Center/RRHA | First Precinct |
| Creighton Court Community Center | Second Precinct |
| Calhoun Community Center and Playground | Third Precinct |
| Richmond Fire Station 5 | Woodville Elementary School |
| Richmond Fire Station 16 | Fairfield Court Elementary School |
| Ambulance Station 40 | Preschool Development Center |

We don't know if prevention resources are already being allocated to these locations. Best locations for prevention and also for basic needs are ones that people can walk to if it is safe enough.

<p>MIECHV is reaching women in the riskiest places.</p>	<p>How does their eligibility criteria differ from that of other service providers?</p> <p>How are other services allocated across space?</p>
--	---

A protective resource that is lacking, according to the community voice, is child care, a concern our geospatial resource-allocation analysis echoes.

Table 31 - The community says its members are the most likely to accept help from the following

Percent of Respondents	Source of Help
57%	of families would most likely accept help from churches.
45%	would most likely to accept help from social workers.
18%	would likely accept help from neighbors.
17%	would be willing to accept help from Partnership for Families.

Source: Robins Foundation Survey, October 2017

The most optimally located churches for prevention resource allocation include the following:

- | | |
|----------------------------------|--|
| Shalom Baptist Fellowship Church | Bible Way Church |
| Sixth Mount Zion Baptist Church | Saint Philip's Protestant Episcopal Church |
| Ebenezer Baptist Church | Bethlehem Baptist Church |
| Swansboro Baptist Church | Mount Olivet Baptist Church |
| New Canaan Baptist Church | Saint John Baptist Church |

Intelligence for COMMUNITY ENGAGEMENT and PREVENTION MESSAGING

The dominant market segments in the top two risk quintiles having the highest exposure levels are more likely than the national average to have the following characteristics and preferences:

More Likely To

- Use public transportation
- Use ridesharing, such as Uber or Lyft
- Carpool
- Walk
- Work from home
- Work in office/administrative support roles
- Work in non-skilled hourly wage positions
- Speak English

Less Likely To

- Graduate high school
- Have a bachelor's or graduate degree
- Be engaged by broadcast/cable TV
- Retire
- Engage in church activities

Marketing Preferences Include:

- Engagement by mobile video, mobile display advertisements, online video, and online display advertisements
- Receptive to email
- Rely on Magazines to be informed (Business and Finance, Music, Teen-oriented, Men's, and Black/African American)
- Pays attention to commercials in a movie
- Interested in mainstream sports, but not as an event preference

Potential Incentives Include:

- Live dance performances
- Jazz and R&B music
- Sports memorabilia/trading cards
- E-books
- Six Flags
- Comedy clubs
- Video games and consoles
- At-home sporting events (transportation limitations for away games)
- Sea World
- Ridesharing

* Comparisons are made to averages for the general population in the USA. Segments as described by Experian's product Mosaic USA

Prevention Concepts

Since a population’s concentrated exposure to adverse experiences, including child abuse and neglect, is directly related to negative outcomes, prevention must be a cross-sector, collaborative effort. The negative outcomes shown in the chart below are also risk factors for ongoing adverse experiences. Hundreds of scientific studies have established these connections, and so attempts to address just one negative outcome in isolation is unlikely to be successful. Therefore, focused efforts to prevent child abuse and neglect must occur in the context of reducing a population’s overall exposure to adverse experiences.

Table 32

→ Exposure →	Adaptations →	Outcome/Risk Factor →
Adverse Childhood Experiences (ACEs): <i>Physical abuse</i> <i>Sexual abuse</i> <i>Emotional abuse</i> <i>Physical neglect</i> <i>Emotional neglect</i> <i>Mother treated violently</i> <i>Household substance abuse</i> <i>Household mental illness</i> <i>Parental separation or divorce</i> <i>Incarcerated household member</i>	Neurodevelopmental maladaptation Epigenetic modifications Altered stress response Disregulated immune response Increased fear response Decreased executive functioning Emotional reactivity	Alcohol and drug abuse Depression and anxiety Psychological disorders Suicidality Teenage pregnancy Single parenthood Sexually transmitted infections Premature birth and low birth weight Infant mortality Risk of intimate partner and sexual violence Risk of aggressive and/or criminal behavior Chronic disease and disability Severe obesity Diabetes Cancer Heart disease and stroke Shorter life expectancy High utilization of health care Low school readiness rates Low 3rd grade reading proficiency Low educational attainment More likely to miss work Unemployment Poverty High residential mobility
Enabling infrastructure	Unhealthy coping mechanisms	
Unmet critical needs and capabilities	Isolation	
Unhealthy social norms		

Prioritizing Prevention Initiatives in Richmond

Violence prevention will constitute an important part of an effective child maltreatment prevention plan in Richmond.

In addition to directly causing safety concerns, violence in dense urban neighborhoods can be an important cause of isolation as it can effectively confine people to their homes for safety. The reported lack of a sense of community among Richmond residents points to the presence of both. In addition, isolation contributes to

depression, anxiety, and substance misuse, which are risk factors for child maltreatment as well as being ACEs for children living in affected homes.

Violent and other types of crime may also exacerbate transportation issues when they create an unsafe environment around bus stops. The dominant psychographic profiles of households inside the highest risk geographies include a likelihood to be reliant on public transportation.

The appendices of the technical report list additional infrastructure locations with significantly higher crime incidences. These locations act as “crime attractors” that enable ongoing criminal activity that threatens residents’ safety.

Concepts Related to Community-Level Prevention Opportunities:

Positive Deviance: Although exposure to multiple ACEs generally results in the outcomes listed above, some people and communities do not display these outcomes because of differing adaptations to their environments and thereby change their outcomes for the better. Since this form of community wisdom could be learned and replicated in other parts of the community, geospatial machine learning taught with such outcome data would help in identifying these types of positive deviance.

Professional Response: The response of medical, first responder, and social work professionals play important roles in ACEs exposure. When addressing outcomes/risk factors, does a professional response serve to increase ACEs for families? For example, in cases of domestic violence, are policies in place to prosecute violent offenders without requiring victims’ cooperation? If animal cruelty is recognized, are child maltreatment and elder abuse also addressed? When women and girls who are of childbearing age but who do not plan on becoming pregnant within the next year are in a medical setting, are long-acting reversible contraceptives made immediately available as the best-in-class pregnancy-prevention option? Are police well trained in de-escalation techniques to avoid incarceration of nonviolent offenders? Are medical, dental, first responder, and child care personnel taught sentinel-injury recognition and subsequent reporting procedures?

Community Leader Response: Community leaders shape social norms and so, when speaking from a position of authority, can influence what is considered acceptable behavior, thereby influencing a community’s exposure to ACEs. For example, does the faith community take a no-tolerance stance with respect to domestic violence? Does the within-school response to sexual abuse of children and teenagers prioritize a child’s stated experience, which is almost always true? In the case of rampant child physical abuse, is physical punishment of children in the home or school setting encouraged?

Infrastructure: Some buildings and places tend to support specific types of criminal behavior. Predictive risk modeling can identify specific areas where risk of child abuse and neglect is particularly high and which buildings and places have significantly more crime events relative to a city as a whole. Safety in these areas can be improved by enforcing code, addressing code violations, implementing Crime Prevention through Environmental Design, replacing abandoned or unsafe buildings with community spaces, and making crime-attracting places less attractive.

Prevention Messaging: Multiple organizations, coalitions, teams, and programs working in the same places with the same people provides an incredible opportunity to deploy impactful prevention messaging. Moreover, any approach to behavioral change follows similar steps, from marketing of designer clothing brands to influencing voting behaviors. Within a prevention context, are the local organizations, coalitions, teams, and programs working together to ensure consistency and lack of conflict in prevention messaging? Are common

risk factors addressed collaboratively to increase the number of times target audiences see or hear prevention messaging? Are all organizations held to an evidence-based standard that does not spread misinformation harmful to communities?

Reduction of Administrative Burden on Vulnerable Communities: Many coalitions, organizations, teams, and programs interface with the same people from the same places, and most conduct surveys and attempt to engage the same target populations. Working in silos, this approach can create an administrative burden in communities in need of services and supports. So, instead of conducting new surveys, new focus groups, new asset-mapping exercises and asking new questions about what the community thinks its problems and their solutions are, how can organizations work together to use the information that has already been gathered in moving toward instituting tactical action? In addition to conserving resources, this approach places less of a burden on community members, most likely improving community engagement.

Data Sharing: The most qualified professional to obtain specific data should be the one collecting that data, and the most reliable data source should be used as the source of that data. For example, if medical data are being collected, it should be by a skilled medical professional. If crime data are being collected, it should be from the police department. Self-reported and survey data can be utilized, but only if those answers can be objectively verified. Answers that can't be objectively verified and represent major risk factors for child maltreatment should not be used in assessing risk.

Implementation Science: The ideals of implementation programs can face significant challenges in breaking down existing silos. Often, “collective impact” type initiatives splinter into sub-groups that mirror previously existing committees and task forces and suffer from the same barriers to change. Thus, whenever possible, cross-sector collaboration aims to simplify, standardize, and automate to maximize impact and resource utilization, with the “backbone” organization(s) “owning” the most protected data and driving continuous quality improvement based on that data.

Philanthropy: Funders set expectations and requirements for what outcomes can and should be measured. But do funders require objective, verifiable outcomes for the ongoing allocation of resources? Are outcomes expectations linked for programs intended to address problems with similar risk factors and target populations? Government, philanthropic, and industry funders are probably in the most powerful position to define success in prevention interventions and encourage adherence to the findings of data-driven continuous quality improvement cycles.

Examples of Child Abuse and Neglect Prevention Initiatives

**Predict-Align-Prevent does not endorse any particular program, service, or organization.*

Abusive Head Trauma Prevention

A community attempting to prevent abusive head injuries and related deaths in infants and toddlers can consider an array of cross-sector prevention activities, many of which overlap with prevention of other types of child maltreatment, risk factors for child maltreatment, and outcomes associated with ACEs.

Important to remember is that such initiatives would ideally be implemented as part of a cohesive, cross-sector plan to address core-community risk factors such as domestic violence, community violence, isolation, crime-attracting infrastructures, lack of access to concrete supports, and unhealthy social norms.

Universal (Community-Wide)

- **Coping skills for caregivers of crying infants:** [Period of PURPLE Crying](#) provides all new parents training to help them understand their child’s development from about 2 weeks of age to 3 to 4 months, focusing particularly on safe caregiver responses to inconsolable crying.
- **New social norms that discourage interpersonal violence:** Community-wide campaigns promoting positive parenting techniques that do not include physical punishment of children, a proven precursor to physical abuse and physical abuse fatalities, is another relevant initiative. One option, the [No Hit Zone](#) program, provides resources for family homes, organizations, and communities, including multiple strategies to effectively influence attitudes, norms, and behaviors around interpersonal violence.
- **Early detection of child maltreatment training for medical professionals:** Early recognition and an effective response to sentinel injuries in a healthcare setting can prevent severe or fatal injury. Professional training, such as that provided by [TRAIN Collaborative](#), has quadrupled the frequency with which children are identified as having experienced a sentinel injury in participating institutions.
- **Combating misinformation about abusive head trauma (AHT) in courts:** Court and legal professionals, medical examiners, journalists, and pediatric physicians called to testify in a criminal proceeding for a case of abusive head trauma should be aware of the findings in professional society consensus statements, such as the [Consensus statement on abusive head trauma in infants and young children](#), which provides an evidence-base for evaluation of AHT. This knowledge is important for prevention because misinformation, perpetuated by paid defense experts, can result in legal proceedings that enable a single male perpetrator to be involved in the abusive deaths of multiple unrelated children from different mothers over time in a single community.
- **Postpartum depression and psychosis supports and awareness:** Postpartum depression and psychosis awareness, screening, and treatment supports, such as are available from [Postpartum Support International](#)
- **ACE awareness and resilience building:** ACE awareness programs, such as [ACE Interface](#), support rapid dissemination of ACE and resilience science and promote understanding and application of the science to improve health and well-being across the lifespan.

High-Risk Areas

- **Safe child care:** Availability of high-quality child care for single working mothers that is cost appropriate, easily accessible, open for the duration of typical working hours, and that also has the capacity to care for infants and children with special needs. Child care is important for prevention so that mothers don’t have to rely upon unrelated adults to care for their infants and children while they are at work. Optimal placement of new child care centers can be identified based on Predict and Align findings.
- **Awareness of perpetrator and child-risk factors:** Mothers or caregivers of infants and toddlers should be aware of risk factors influencing the safety of their children who are being cared for by unbonded adults.
- **New social norms that discourage community and interpersonal violence:** Violence spreads like a contagious disease and can be prevented by reducing exposure. One option, [Cure Violence](#), is an

effective community-based violence-prevention program that has demonstrated significant violence reduction in communities worldwide. *Violence prevention is critical because unsafe communities are isolated communities, and resilience is built on community connections and relationships.*

- **Readily available services for victims of domestic violence:** Family justice centers, such as [One Safe Place](#) concentrate resources for victims of domestic violence and often include child care, pet care, and emergency housing. Domestic violence is the most predictive risk feature for child maltreatment in Richmond and is also one of the most important causes of homelessness for women and children nationally.

Mothers and Caregivers

- Evidence-based home visitation and parenting programs, such as [Nurse Family Partnership](#) and [Triple P Parenting](#), may provide mothers and caregivers with protective parenting knowledge and skills.

Perpetrator Risk

- [Housing availability for formerly incarcerated people](#) with violent criminal histories that does not include responsibility to care for infants or toddlers.

Prevent: Next Steps for Richmond

In the PREDICT phase, we identified the places where children are at greatest risk of maltreatment and that are ranked as the most important risk features by correlation with child maltreatment events. The majority of child removals and child-maltreatment fatalities occurred in the predicted highest risk locations.

During the ALIGN phase, we identified the following: the existing community voice, potential protective assets, potential community “champions” for prevention work, coalitions and service providers working on problems with similar risk factors and target populations, specific crime-attracting infrastructure, and psychographics for optimal community engagement.

Remaining data needs for analysis include the x-y coordinates for specified death types so that cross-sector stakeholders can visualize the co-occurrence of their ACE-related focal areas and the inextricably linked sites of child abuse and neglect. This recognition represents a critical step for cross-sector engagement in prevention initiatives.

The next step is working with cross-sector stakeholders to use this intelligence source in designing tactical action to prevent child maltreatment, and strategic planning will focus on the following:

- Collaboration among coalitions to prevent problems involving similar risk factors and target populations (to minimize duplicative or conflicting efforts and maximize shared resources)
- Executive leadership and policies in support of evidence-based and evidence-informed practices
- A cross-sector customer-experience design that engages and sustains community relationships
- Longitudinal, population-level health and safety metrics with which to evaluate the effectiveness of aligned resources
- Objectively effective prevention programs and services
- Prevention funding to meet capacity needs for effective services

TO BE DEVELOPED WHEN DATA ARE AVAILABLE

Where Prevention Resources are Currently Focused ...

Success of Prevention Programs is Currently Being Measured by ...

Prevent Tools: Risk and Protective Resources

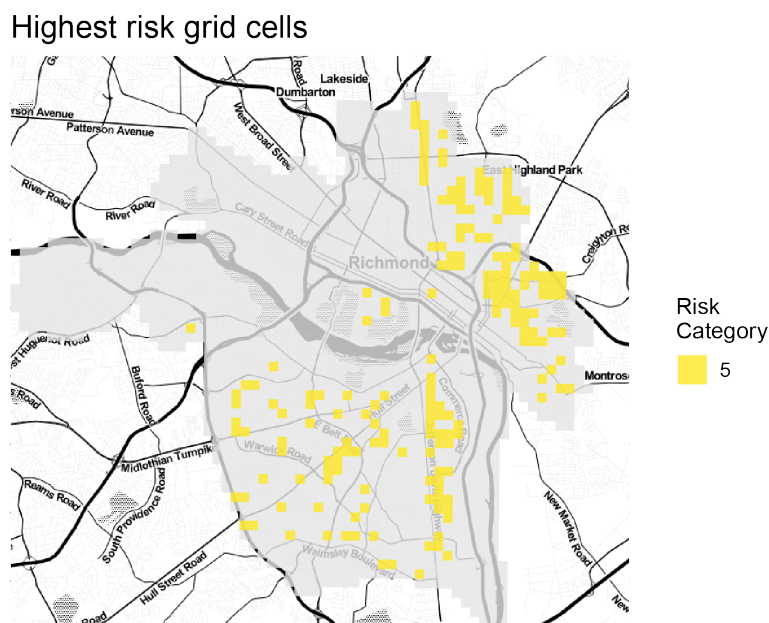


Figure 53

Protective features located in the highest risk grid cells area available in *Table 33 - Protective features in the highest risk grid cells* in Appendix A.

Table 34 - Risk and Protective Features by Risk Area shows infrastructure points located in the highest risk grid cells, i.e., those having statistically significant, higher crime rates than other locations. To determine statistical significance, crimes - in this case, aggravated assaults, aggravated domestic assaults, simple domestic assaults, and drug/narcotic violations - were aggregated at the grid cell level. Local Moran's I was then calculated for each grid cell, and those grid cells with a p -value of less than 0.05 were found to have statistically significant, higher crime rates than other Richmond locations. The entries in the table below are located in grid cells that were determined to have statistically significant crime rates and to be located in the highest risk quintile. This methodology was repeated for the second highest risk quintile also.

There are three types of building violations: general violations, unfit structures, and unsafe structures. 'General violations' occur when a structure fails to follow general building code requirements. According to

Commonwealth of Virginia maintenance code, ‘unfit structures’ have been determined to be dangerous to the health, safety, and welfare of its occupants or of members of the general public. An ‘unsafe structure’ is one that has been found to be dangerous to the health and safety of its occupants or of members of the general public, one that contains unsafe equipment, or one damaged such that complete or partial collapse is likely. Unsecured or open vacant structures are also categorized as unsafe.

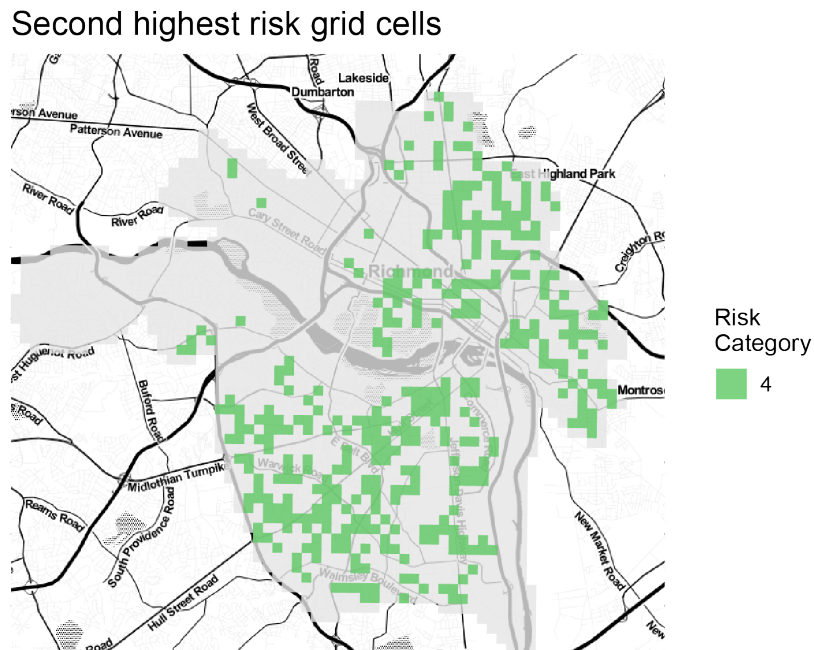


Figure 54

For a list of protective features located in the second highest risk quintile’s grid cells, see *Table 35 - Protective features in the second highest risk grid cells*, Appendix A.

A list of infrastructures located in the second highest risk quintile’s grid cells, i.e., those having statistically significant, higher crime rates than other locations, is included in *Table 36 - Infrastructure in second highest risk grid cells with statistically significant, higher crime rates than other locations*, Appendix A

APPENDICES

Appendix A: Risk and Protective Features by Risk Area

Table 33 - Protective features in the highest risk grid cells

Protective Land Use	Name
Community Center	Creighton Court Community Center
Community Center	Hillside Court Community Center
Community Center	Powhatan's Hill Community Center
Community Center	Thomas B. Smith Community Center/Ruffin Road Playground
Community Center	Highland Park Plaza Community Center (Anne Hardy Plaza)
Community Center	Blackwell Community Center (Charlie D. Sydnor Playground)
Community Center	Whitcomb Court Community Center and Playground
Community Center	Fairfield Court Community Center/RRHA
Fire Station	Richmond Fire Station 8
Fire Station	Richmond Fire Station 11
Fire Station	Richmond Fire Station 16
Fire Station	Richmond Fire Station 15
Fire Station	Ambulance Station 10
Homeless Shelter	None given
Homeless Shelter	None given
Homeless Shelter	None given
Homeless Shelter	None given
Library	Hull Street Branch Library
Library	East End Branch Library
Library	North Avenue Branch Library
Church	Shalom Baptist Fellowship Church
Church	New Canaan Baptist Church
Church	Beulah Baptist Church
Church	Church of God Prophecy
Church	Mount Vernon Baptist Church
Church	5th Street Baptist Church
Church	Ginter Park Presbyterian Church
Church	Fourth Baptist Church
Church	31st Street Baptist Church
Church	Immanuel Pentecostal Church
Church	Saint Elizabeth Catholic Church
Church	Saint Philip's Protestant Episcopal Church
Church	Second Baptist Church
Church	Ginter Park United Methodist Church
Church	Northside Crusader Baptist Church
Church	Bethlehem Baptist Church

Protective Land Use	Name
Church	Highland Park Methodist Church
Church	The Mayo Memorial Church House
Police Station	First Precinct
School	Richmond Acceleration Program (Blackwell Annex)
School	Blackwell Elementary School
School	Oak Grove Bellemeade Elementary School
School	Martin Luther King Jr. Middle School
School	Woodville Elementary School
School	Fairfield Court Elementary School
School	JEB Stuart Elementary School
School	Ginter Park Elementary School
School	John Marshall High School
School	George Mason Elementary School
School	Swansboro Elementary School
School	Preschool Development Center
School	Richmond Detention Center
School	Preschool Learning Center at MLK Middle School
School	Preschool Learning Center at Blackwell Elementary School

Table 34 - Risk and Protective Features by Risk Area

Infrastructure Type	Name	Address
ABC Stores	ABC #187	Venable St, Richmond, VA, 23223
ABC Stores	ABC #251	North Ave, Richmond, VA, 23222
Building Violations	General Violations	Columbia St, Richmond, VA, 23234
Building Violations	General Violations	Jefferson Davis Hwy, Richmond, VA, 23234
Building Violations	General Violations	Bowen St, Richmond, VA, 23224
Building Violations	General Violations	Midlothian Tpke, Richmond, VA, 23225
Building Violations	General Violations	Overlook St, Richmond, VA, 23224
Building Violations	General Violations	Willis St, Richmond, VA, 23224
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	N 25th St, Richmond, VA, 23223
Building Violations	General Violations	N 25th St, Richmond, VA, 23223
Building Violations	General Violations	N 25th St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	N 20th St, Richmond, VA, 23223
Building Violations	General Violations	Q St, Richmond, VA, 23223
Building Violations	General Violations	Fairmount Ave, Richmond, VA, 23223
Building Violations	General Violations	Fairmount Ave, Richmond, VA, 23223
Building Violations	General Violations	Fairmount Ave, Richmond, VA, 23223

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Infrastructure Type	Name	Address
Building Violations	General Violations	N 22nd St, Richmond, VA, 23223
Building Violations	General Violations	N 23rd St, Richmond, VA, 23223
Building Violations	General Violations	N 22nd St, Richmond, VA, 23223
Building Violations	General Violations	N 21st St, Richmond, VA, 23223
Building Violations	General Violations	Fairmount Ave, Richmond, VA, 23223
Building Violations	General Violations	N 22nd St, Richmond, VA, 23223
Building Violations	General Violations	N 21st St, Richmond, VA, 23223
Building Violations	General Violations	Nine Mile Rd, Richmond, VA, 23223
Building Violations	General Violations	Bunche Pl, Richmond, VA, 23223
Building Violations	General Violations	Redd St, Richmond, VA, 23223
Building Violations	General Violations	Coalter St, Richmond, VA, 23223
Building Violations	General Violations	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	General Violations	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	General Violations	Spotsylvania St, Richmond, VA, 23223
Building Violations	General Violations	Rogers St, Richmond, VA, 23223
Building Violations	General Violations	N 21st St, Richmond, VA, 23223
Building Violations	General Violations	N 23rd St, Richmond, VA, 23223
Building Violations	General Violations	Newbourne St, Richmond, VA, 23223
Building Violations	General Violations	Ford Ave, Richmond, VA, 23223
Building Violations	General Violations	Ford Ave, Richmond, VA, 23223
Building Violations	General Violations	Newbourne St, Richmond, VA, 23223
Building Violations	General Violations	N 20th St, Richmond, VA, 23223
Building Violations	General Violations	N 19th St, Richmond, VA, 23223
Building Violations	General Violations	Fairfield Ave, Richmond, VA, 23223
Building Violations	General Violations	Fairfield Ave, Richmond, VA, 23223
Building Violations	General Violations	W Charity St, Richmond, VA, 23220
Building Violations	General Violations	St John St, Richmond, VA, 23220
Building Violations	General Violations	St John St, Richmond, VA, 23220
Building Violations	General Violations	E Hill St, Richmond, VA, 23219
Building Violations	General Violations	Whitcomb St, Richmond, VA, 23223
Building Violations	General Violations	Whitcomb St, Richmond, VA, 23223
Building Violations	General Violations	Dill Ave, Richmond, VA, 23222
Building Violations	General Violations	3rd Ave, Richmond, VA, 23222
Building Violations	General Violations	Dill Ave, Richmond, VA, 23222
Building Violations	General Violations	Garland Ave, Richmond, VA, 23222
Building Violations	General Violations	Garland Ave, Richmond, VA, 23222
Building Violations	General Violations	Hanes Ave, Richmond, VA, 23222
Building Violations	General Violations	Hanes Ave, Richmond, VA, 23222
Building Violations	General Violations	Garland Ave, Richmond, VA, 23222
Building Violations	General Violations	Garland Ave, Richmond, VA, 23222
Building Violations	General Violations	Hanes Ave, Richmond, VA, 23222
Building Violations	General Violations	Utah Pl, Richmond, VA, 23222
Building Violations	General Violations	3rd Ave, Richmond, VA, 23222

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Infrastructure Type	Name	Address
Building Violations	General Violations	Utah Pl, Richmond, VA, 23222
Building Violations	General Violations	1st Ave, Richmond, VA, 23222
Building Violations	General Violations	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	General Violations	Montrose Ave, Richmond, VA, 23222
Building Violations	General Violations	Old Brook Rd, Richmond, VA, 23227
Building Violations	General Violations	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	General Violations	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	General Violations	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Drewry St, Richmond, VA, 23224
Building Violations	Unfit Structure	Harwood St, Richmond, VA, 23224
Building Violations	Unfit Structure	Keswick Ave, Richmond, VA, 23224
Building Violations	Unfit Structure	Drewry St, Richmond, VA, 23224
Building Violations	Unfit Structure	Lone St, Richmond, VA, 23224
Building Violations	Unfit Structure	Lone St, Richmond, VA, 23224
Building Violations	Unfit Structure	Decatur St, Richmond, VA, 23224
Building Violations	Unfit Structure	Hull St, Richmond, VA, 23224
Building Violations	Unfit Structure	N 26th St, Richmond, VA, 23223
Building Violations	Unfit Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unfit Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unfit Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unfit Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unfit Structure	Nine Mile Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	N 29th St, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Walcott Pl, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Walcott Pl, Richmond, VA, 23223
Building Violations	Unfit Structure	Creighton Rd, Richmond, VA, 23223
Building Violations	Unfit Structure	Walcott Pl, Richmond, VA, 23223
Building Violations	Unfit Structure	W Charity St, Richmond, VA, 23220
Building Violations	Unfit Structure	Glenlea Ave, Richmond, VA, 23223
Building Violations	Unfit Structure	Dill Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	3rd Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	3rd Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Hanes Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Hanes Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	E Brookland Park Blvd, Richmond, VA, 23222
Building Violations	Unfit Structure	2nd Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	3rd Ave, Richmond, VA, 23222

Infrastructure Type	Name	Address
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unfit Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unsafe Structure	Columbia St, Richmond, VA, 23234
Building Violations	Unsafe Structure	Midlothian Tpke, Richmond, VA, 23225
Building Violations	Unsafe Structure	Old Warwick Rd, Richmond, VA, 23225
Building Violations	Unsafe Structure	Harwood St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Harwood St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Drewry St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Chambers St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Minefee St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Decatur St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Hull St, Richmond, VA, 23224
Building Violations	Unsafe Structure	N 20th St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	Fairmount Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Bryan St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 20th St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 29th St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Coalter St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Redd St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 21st St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 23rd St, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 23rd St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Ford Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	Ford Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	Ford Ave, Richmond, VA, 23223
Building Violations	Unsafe Structure	N 23rd St, Richmond, VA, 23223
Building Violations	Unsafe Structure	Phaup St, Richmond, VA, 23223
Building Violations	Unsafe Structure	St Paul St, Richmond, VA, 23220
Building Violations	Unsafe Structure	Whitcomb St, Richmond, VA, 23223
Building Violations	Unsafe Structure	4th Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	4th Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Dill Ave, Richmond, VA, 23222

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Infrastructure Type	Name	Address
Building Violations	Unsafe Structure	Garland Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Hanes Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Garland Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Hanes Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Hanes Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Garland Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	3rd Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	3rd Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	1st Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	2nd Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	W Laburnum Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	North Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Old Brook Rd, Richmond, VA, 23227
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23227
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23227
Bus Stop	Stop Number: 1435	Jefferson Davis & Terminal
Bus Stop	Stop Number: 1419	Jefferson Davis & Lumpkin
Bus Stop	Stop Number: 1420	Jefferson Davis & Lumpkin
Bus Stop	Stop Number: 1434	Jefferson Davis & Terminal
Bus Stop	Stop Number: 723	Chambers & Bowen
Bus Stop	Stop Number: 722	Chambers & Bowen
Bus Stop	Stop Number: 726	Chambers & Minefee
Bus Stop	Stop Number: 725	Chambers & Minefee
Bus Stop	Stop Number: 600	Carnation & Atmore
Bus Stop	Stop Number: 603	Carnation & Midlothian
Bus Stop	Stop Number: 604	Carnation & Midlothian
Bus Stop	Stop Number: 607	Carnation & Warwick
Bus Stop	Stop Number: 1776	Midlothian & Warwick
Bus Stop	Stop Number: 1777	Midlothian & Warwick
Bus Stop	Stop Number: 1186	Harwood & 21st
Bus Stop	Stop Number: 724	Chambers & Harwood
Bus Stop	Stop Number: 1579	Lone & Harwood
Bus Stop	Stop Number: 1578	Lone & Harwood
Bus Stop	Stop Number: 606	Carnation at Newport Manor
Bus Stop	Stop Number: 1577	Lone & Bruce
Bus Stop	Stop Number: 1576	Lone & Bruce
Bus Stop	Stop Number: 1264	Hull & 14th
Bus Stop	Stop Number: 1263	Hull & 14th
Bus Stop	Stop Number: 1261	Hull & 12th
Bus Stop	Stop Number: 91	25th & Q
Bus Stop	Stop Number: 103	25th & Venable
Bus Stop	Stop Number: 93	25th & R

RICHMOND, VIRGINIA
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Infrastructure Type	Name	Address
Bus Stop	Stop Number: 1831	Mosby & O
Bus Stop	Stop Number: 2432	Mosby & Leigh
Bus Stop	Stop Number: 1833	Mosby & P
Bus Stop	Stop Number: 1832	Mosby & P
Bus Stop	Stop Number: 1836	Mosby & Q
Bus Stop	Stop Number: 68	22nd & Fairmount
Bus Stop	Stop Number: 69	22nd & Fairmount
Bus Stop	Stop Number: 72	22nd & R
Bus Stop	Stop Number: 70	22nd & O
Bus Stop	Stop Number: 71	22nd & Q
Bus Stop	Stop Number: 1835	Mosby & Q
Bus Stop	Stop Number: 1725	Mechanicsville & Littlepage
Bus Stop	Stop Number: 1837	Mosby & T
Bus Stop	Stop Number: 1830	Mosby & Fairmount
Bus Stop	Stop Number: 76	22nd & U
Bus Stop	Stop Number: 75	22nd & U
Bus Stop	Stop Number: 109	29th & Purcell
Bus Stop	Stop Number: 800	Creighton at Community Center
Bus Stop	Stop Number: 799	Creighton at Family Dollar
Bus Stop	Stop Number: 1877	Nine Mile & Bunche
Bus Stop	Stop Number: 1881	Nine Mile & Bunche
Bus Stop	Stop Number: 880	Fairfield Way at City Jail
Bus Stop	Stop Number: 769	Coalter & Redd
Bus Stop	Stop Number: 770	Coalter & Richmond
Bus Stop	Stop Number: 1727	Mechanicsville & Redd
Bus Stop	Stop Number: 1722	Mechanicsville & Brauers
Bus Stop	Stop Number: 1728	Mechanicsville & Richmond
Bus Stop	Stop Number: 2411	X & 22nd
Bus Stop	Stop Number: 2410	X & 22nd
Bus Stop	Stop Number: 79	22nd & W
Bus Stop	Stop Number: 1452	Kane & 29th
Bus Stop	Stop Number: 1850	Newbourne & 29th
Bus Stop	Stop Number: 801	Creighton & Kane
Bus Stop	Stop Number: 3384	Fairfield & Selden
Bus Stop	Stop Number: 1236	Hildreth & Ford
Bus Stop	Stop Number: 907	Ford & Sussex
Bus Stop	Stop Number: 905	Ford & Bryan
Bus Stop	Stop Number: 185	Accomodation & Gay
Bus Stop	Stop Number: 62	21st & Fairfield
Bus Stop	Stop Number: 81	23rd & Fairfield
Bus Stop	Stop Number: 85	23rd & Selden
Bus Stop	Stop Number: 64	21st & Phaup
Bus Stop	Stop Number: 3385	25th & Phaup

RICHMOND, VIRGINIA
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Infrastructure Type	Name	Address
Bus Stop	Stop Number: 524	Brook & Chamberlayne Overpass
Bus Stop	Stop Number: 681	Chamberlayne & Calhoun
Bus Stop	Stop Number: 677	Chamberlayne & Baker
Bus Stop	Stop Number: 682	Chamberlayne Pkwy & Charity
Bus Stop	Stop Number: 51	1st & Hill
Bus Stop	Stop Number: 55	1st & Federal
Bus Stop	Stop Number: 50	1st & Federal
Bus Stop	Stop Number: 52	1st & Hospital
Bus Stop	Stop Number: 2329	Whitcomb & Conrad
Bus Stop	Stop Number: 2333	Whitcomb & Redwood
Bus Stop	Stop Number: 2332	Whitcomb & Mechanicsville
Bus Stop	Stop Number: 2330	Whitcomb & Deforest
Bus Stop	Stop Number: 1932	North & Essex
Bus Stop	Stop Number: 1936	North & Essex
Bus Stop	Stop Number: 1943	North & Hooper
Bus Stop	Stop Number: 1942	North & Hooper
Bus Stop	Stop Number: 140	4th & Custer
Bus Stop	Stop Number: 139	4th & Custer
Bus Stop	Stop Number: 543	Brookland Park & 4th
Bus Stop	Stop Number: 544	Brookland Park & 4th
Bus Stop	Stop Number: 1931	North & Brookland Park
Bus Stop	Stop Number: 1934	North & Crawford
Bus Stop	Stop Number: 1933	North & Crawford
Bus Stop	Stop Number: 569	Brookland Park Boulevard & North
Bus Stop	Stop Number: 42	1st & Burns
Bus Stop	Stop Number: 45	1st & Pollock
Bus Stop	Stop Number: 44	1st & Milton
Bus Stop	Stop Number: 713	Chamberlayne & Walton
Bus Stop	Stop Number: 694	Chamberlayne & Laburnum
Bus Stop	Stop Number: 693	Chamberlayne & Laburnum
Bus Stop	Stop Number: 701	Chamberlayne & Ordway
Bus Stop	Stop Number: 2641	W Laburnum & Chamberlayne
Bus Stop	Stop Number: 2758	W Laburnum & Chamberlayne
Bus Stop	Stop Number: 1948	North & Montrose
Bus Stop	Stop Number: 1951	North & Moss Side
Bus Stop	Stop Number: 1944	North & Laburnum
Bus Stop	Stop Number: 1949	North & Montrose
Bus Stop	Stop Number: 1844	Moss Side & North
Bus Stop	Stop Number: 2643	W Laburnum & Montrose
Bus Stop	Stop Number: 2756	W Laburnum & Montrose
Bus Stop	Stop Number: 700	Chamberlayne & Ordway
Bus Stop	Stop Number: 683	Chamberlayne & Claremont
Bus Stop	Stop Number: 755	Claremont & Chamberlayne

RICHMOND, VIRGINIA
TECHNICAL REPORT



Infrastructure Type	Name	Address
Bus Stop	Stop Number: 678	Chamberlayne & Bellevue
Convenience Grocery Store	7 ELEVEN INC & MANMEET INC	2922 Jefferson Davis Hwy, Richmond, VA, 23234
Convenience Grocery Store	KASANA INC	6600 Midlothian Tpke, Richmond, VA, 23225
Convenience Grocery Store	NASSER ENTERPRISES INC	2438 Venable St, Richmond, VA, 23223
Convenience Grocery Store	25TH STREET MARKET INC	1009 N 25th St, Richmond, VA, 23223
Convenience Grocery Store	APPLE 5 LLC	1538 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	LABS CONVENIENCE LLC	1321 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	THE PARK EXPRESS CONVENIENCE INC	1401 E Brookland Park Blvd, Richmond, VA, 23222
Convenience Grocery Store	Y & WON INC	1404 E Brookland Park Blvd, Richmond, VA, 23222
Convenience Grocery Store	SEIFU BEYENE INC	3000 Hanes Ave, Richmond, VA, 23222
Convenience Grocery Store	RVA NORTH CORP	2930 North Ave, Richmond, VA, 23222
Gas Station	Shell	6600 Midlothian Tpke, Richmond, VA, 23225
Gas Station	Sunoco	1401 E Brookland Park Blvd, Richmond, VA, 23222
Gas Station	Express Mart	2930 North Ave, Richmond, VA, 23222
Motels	Camelot Inn	6619 Midlothian Tpke, Richmond, VA, 23225
Motels	Shiv Krupa Hospitality	6619 Midlothian Tpke, Richmond, VA, 23225
Motels	Regal Inn Motel	6620 Midlothian Tpke, Richmond, VA, 23225
Motels	Midlothian Inn	6523 Midlothian Tpke, Richmond, VA, 23225
Motels	Host Inn	6621 Midlothian Tpke, Richmond, VA, 23225
Motels	Travel Inn	6511 Midlothian Tpke, Richmond, VA, 23225
Motels	Econo Lodge	6523 Midlothian Tpke, Richmond, VA, 23225
Motels	Eagle Inn	6515 Midlothian Tpke, Richmond, VA, 23225
Motels	Richmond Inn & Suites	6346 Midlothian Tpke, Richmond, VA, 23225
Motels	Rodeway Inn	6346 Midlothian Tpke, Richmond, VA, 23225
Nail and Hair Salons	Kate Beauty Express	102 W Brookland Park Blvd, Richmond, VA, 23222
Restaurant	TORTILLERIA AZTECA LLC	3001 Jefferson Davis Hwy, Richmond, VA, 23234
Restaurant	DONGNAN GOURMET INC	6601 Midlothian Tpke, Richmond, VA, 23225
Restaurant	HAVANA CONNECTIONS LLC	6346 Midlothian Tpke, Richmond, VA, 23225
Restaurant	BARZO RESTAURANTS LLC	10 E Brookland Park Blvd, Richmond, VA, 23222

Table 35 - Protective features in the second highest risk grid cells

Protective Land Use	Name
Community Center	Calhoun Community Center and Playground

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Protective Land Use	Name
Community Center	Chimborazo Community Center
Community Center	Pine Camp Community Center
Community Center	Hotchkiss Community Center
Community Center	Bellemeade Community Center
Fire Station	Richmond Fire Station 13
Fire Station	Richmond Fire Station 22
Fire Station	Ambulance Station 21
Fire Station	Richmond Fire Station 21
Fire Station	Richmond Fire Station 1
Fire Station	Richmond Fire Station 5
Fire Station	Ambulance Station 40
Fire Station	Richmond Fire Station 14
Fire Station	Richmond Fire Station 24
Homeless Shelter	None given
Library	Broad Rock Branch Library
Library	Ginter Park Branch Library
Library	Main Library
Church	Weatherford Baptist Church
Church	Fountain of Deliverance Outreach Church
Church	New Bethel Holy Church
Church	Swansboro Baptist Church
Church	Morning Star Baptist Church
Church	Ebenezer AME Church
Church	Ramsey Memorial United Methodist Church
Church	New Day Church of God
Church	Tabernacle Baptist Church
Church	Northminster Baptist Church
Church	Providence Park Baptist Church
Church	St James Armenian Church
Church	Ginter Park Baptist Church
Church	The Church of the Sacred Heart
Church	Saint James's Episcopal Church
Church	Sixth Mount Zion Baptist Church
Church	Second Presbyterian Church
Church	Harvest Renewal Church
Church	Mount Olivet Baptist Church
Church	Fifth Baptist Church
Church	Cedar Street Memorial Baptist Church
Church	Carlisle Avenue Baptist Church
Church	Mount Calvary Baptist Church
Church	All Saints Apostolic Church
Church	All Souls Presbyterian Church
Church	Ephesus Seventh Day Adventist Church of Richmond

Protective Land Use	Name
Church	Chicago Avenue Baptist Church
Church	First Baptist Church of South Richmond
Church	Korean Presbyterian Church
Church	Redeemed Church of God
Church	Metropolitan African American Baptist Church
Church	Holy Rosary Catholic Church
Church	Greater Brook Road Baptist Church
Church	Saint John Baptist Church
Church	Church of Jesus Christ of Latter Day Saints Grace Street
Church	Trinity Baptist Church
Church	Bethlehem Lutheran Church
Church	Saint Paul Catholic Church
Church	First African Baptist Church
Church	Garland Avenue Baptist Church
Church	Resurrection Lutheran Church
Church	Word for Living Ministries Church of God in Christ
Church	Saint Giles Presbyterian Church
Church	Grace Covenant Presbyterian Church
Church	St. John's United Church of Christ
Church	First English Evangelical Lutheran Church
Church	Ebenezer Baptist Church
Police Station	Richmond Police Headquarters
Police Station	Third Precinct
Police Station	Fourth Precinct
School	Oak Grove Elementary School
School	Miles Jerome Jones Elementary School
School	Huguenot High School
School	Ginter Park Elementary School Annex
School	Open High School
School	Overby-Sheppard Elementary School
School	Thomas H Henderson Middle School
School	Chimborazo Elementary School
School	Clark Springs Elementary School (Closed)
School	13 Acres Exceptional Education School
School	GH Reid Elementary School
School	Preschool Learning Center at Maymont
School	Westover Hills Elementary School
School	REAL School
School	Richmond Community High School
Oasis (VDSS child welfare online database)	None given
Oasis	None given
Oasis	None given
Oasis	None given

Protective Land Use	Name
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given
Oasis	None given

Table 36 - Infrastructure in second highest risk grid cells with statistically significant, higher crime rates than other locations

Infrastructure Type	Name	Address
Building Violations	General Violations	Jefferson Davis Hwy, Richmond, VA, 23234
Building Violations	General Violations	Commerce Rd, Richmond, VA, 23224
Building Violations	General Violations	Ingram Ave, Richmond, VA, 23224
Building Violations	General Violations	E 18th St, Richmond, VA, 23224
Building Violations	General Violations	E 18th St, Richmond, VA, 23224
Building Violations	General Violations	Keswick Ave, Richmond, VA, 23224
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Venable St, Richmond, VA, 23223
Building Violations	General Violations	Nine Mile Rd, Richmond, VA, 23223
Building Violations	General Violations	E Grace St, Richmond, VA, 23219
Building Violations	General Violations	E Grace St, Richmond, VA, 23219
Building Violations	General Violations	N 3rd St, Richmond, VA, 23219
Building Violations	General Violations	N 3rd St, Richmond, VA, 23219
Building Violations	General Violations	N 22nd St, Richmond, VA, 23223
Building Violations	General Violations	W Broad St, Richmond, VA, 23220
Building Violations	General Violations	W Marshall St, Richmond, VA, 23220
Building Violations	General Violations	W Marshall St, Richmond, VA, 23220
Building Violations	General Violations	W Marshall St, Richmond, VA, 23220

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Infrastructure Type	Name	Address
Building Violations	General Violations	W Broad St, Richmond, VA, 23220
Building Violations	General Violations	Brook Rd, Richmond, VA, 23220
Building Violations	General Violations	W Marshall St, Richmond, VA, 23220
Building Violations	General Violations	N Adams St, Richmond, VA, 23220
Building Violations	General Violations	W Marshall St, Richmond, VA, 23220
Building Violations	General Violations	St James St, Richmond, VA, 23220
Building Violations	General Violations	W Jackson St, Richmond, VA, 23220
Building Violations	General Violations	W Jackson St, Richmond, VA, 23220
Building Violations	General Violations	St James St, Richmond, VA, 23220
Building Violations	General Violations	Leigh St, Richmond, VA, 23220
Building Violations	General Violations	St Peter St, Richmond, VA, 23220
Building Violations	General Violations	St Peter St, Richmond, VA, 23220
Building Violations	General Violations	N 1st St, Richmond, VA, 23219
Building Violations	General Violations	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	General Violations	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	General Violations	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	General Violations	Maddox St, Richmond, VA, 23223
Building Violations	General Violations	Overbrook Rd, Richmond, VA, 23222
Building Violations	General Violations	Chamberlayne Ave, Richmond, VA, 23222
Building Violations	General Violations	N Lombardy St, Richmond, VA, 23220
Building Violations	General Violations	North Ave, Richmond, VA, 23222
Building Violations	General Violations	Enslow Ave, Richmond, VA, 23222
Building Violations	General Violations	Carolina Ave, Richmond, VA, 23222
Building Violations	General Violations	Enslow Ave, Richmond, VA, 23222
Building Violations	General Violations	Enslow Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Joplin Ave, Richmond, VA, 23224
Building Violations	Unfit Structure	Keswick Ave, Richmond, VA, 23224
Building Violations	Unfit Structure	Keswick Ave, Richmond, VA, 23224
Building Violations	Unfit Structure	E 18th St, Richmond, VA, 23224
Building Violations	Unfit Structure	Venable St, Richmond, VA, 23223
Building Violations	Unfit Structure	N 30th St, Richmond, VA, 23223
Building Violations	Unfit Structure	W Broad St, Richmond, VA, 23220
Building Violations	Unfit Structure	N 25th St, Richmond, VA, 23223
Building Violations	Unfit Structure	W Leigh St, Richmond, VA, 23220
Building Violations	Unfit Structure	Mechanicsville Tpke, Richmond, VA, 23223
Building Violations	Unfit Structure	North Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Woodcliff Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Enslow Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Groveland Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Carolina Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Carolina Ave, Richmond, VA, 23222
Building Violations	Unfit Structure	Carolina Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Jefferson Davis Hwy, Richmond, VA, 23234
Building Violations	Unsafe Structure	Lochaven Blvd, Richmond, VA, 23234

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Infrastructure Type	Name	Address
Building Violations	Unsafe Structure	Ingram Ave, Richmond, VA, 23224
Building Violations	Unsafe Structure	Keswick Ave, Richmond, VA, 23224
Building Violations	Unsafe Structure	E 18th St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Keswick Ave, Richmond, VA, 23224
Building Violations	Unsafe Structure	E 18th St, Richmond, VA, 23224
Building Violations	Unsafe Structure	Venable St, Richmond, VA, 23223
Building Violations	Unsafe Structure	W Broad St, Richmond, VA, 23220
Building Violations	Unsafe Structure	E Broad St, Richmond, VA, 23219
Building Violations	Unsafe Structure	W Broad St, Richmond, VA, 23220
Building Violations	Unsafe Structure	W Marshall St, Richmond, VA, 23220
Building Violations	Unsafe Structure	W Broad St, Richmond, VA, 23220
Building Violations	Unsafe Structure	Brook Rd, Richmond, VA, 23220
Building Violations	Unsafe Structure	W Broad St, Richmond, VA, 23220
Building Violations	Unsafe Structure	N 23rd St, Richmond, VA, 23223
Building Violations	Unsafe Structure	St Peter St, Richmond, VA, 23220
Building Violations	Unsafe Structure	Chamberlayne Pkwy, Richmond, VA, 23220
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Chamberlayne Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Barton Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	North Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Enslow Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	1st Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Woodcliff Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Enslow Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Woodcliff Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Carolina Ave, Richmond, VA, 23222
Building Violations	Unsafe Structure	Maryland Ave, Richmond, VA, 23222
Bus Stop	Stop Number: 1432	Jefferson Davis & Summer Hill
Bus Stop	Stop Number: 1418	Jefferson Davis & Lockhaven
Bus Stop	Stop Number: 1433	Jefferson Davis & Summer Hill
Bus Stop	Stop Number: 35	18th & Joplin
Bus Stop	Stop Number: 34	18th & Joplin
Bus Stop	Stop Number: 579	Bruce & 18th St
Bus Stop	Stop Number: 1405	Jefferson Davis & Decatur
Bus Stop	Stop Number: 794	Cowardin & Hull
Bus Stop	Stop Number: 1431	Jefferson Davis & Stockton
Bus Stop	Stop Number: 1297	Hull & Cowardin
Bus Stop	Stop Number: 1296	Hull & Cowardin
Bus Stop	Stop Number: 86	23rd & Venable
Bus Stop	Stop Number: 78	22nd & Venable
Bus Stop	Stop Number: 1867	Nine Mile & 30th
Bus Stop	Stop Number: 107	29th & Nine Mile

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Infrastructure Type	Name	Address
Bus Stop	Stop Number: 1865	Nine Mile & 29th
Bus Stop	Stop Number: 1864	Nine Mile & 29th
Bus Stop	Stop Number: 1668	Marshall & 2nd
Bus Stop	Stop Number: 364	Broad & 1st
Bus Stop	Stop Number: 368	Broad & 3rd
Bus Stop	Stop Number: 363	Broad & 1st
Bus Stop	Stop Number: 365	Broad & 2nd
Bus Stop	Stop Number: 1051	Grace & 3rd
Bus Stop	Stop Number: 1050	Grace & 1st
Bus Stop	Stop Number: 370	Broad & 4th
Bus Stop	Stop Number: 373	Broad & 5th
Bus Stop	Stop Number: 371	Broad at 4th
Bus Stop	Stop Number: 80	22nd & W
Bus Stop	Stop Number: 77	22nd & V
Bus Stop	Stop Number: 455	Broad & Monroe
Bus Stop	Stop Number: 385	Broad & Adams
Bus Stop	Stop Number: 439	Broad & Jefferson
Bus Stop	Stop Number: 454	Broad & Monroe
Bus Stop	Stop Number: 440	Broad & Jefferson
Bus Stop	Stop Number: 1065	Grace & Madison
Bus Stop	Stop Number: 2412	X & 24th
Bus Stop	Stop Number: 88	24th & Y St
Bus Stop	Stop Number: 87	24th & Peter Paul
Bus Stop	Stop Number: 2423	Chamberlayne & Price
Bus Stop	Stop Number: 188	Chamberlayne & Price
Bus Stop	Stop Number: 2436	Leigh & Judah
Bus Stop	Stop Number: 1531	Leigh & Adams
Bus Stop	Stop Number: 684	Chamberlayne & Duval
Bus Stop	Stop Number: 692	Chamberlayne & Jackson
Bus Stop	Stop Number: 854	Duval & 1st
Bus Stop	Stop Number: 47	1st & Baker
Bus Stop	Stop Number: 49	1st & Duval
Bus Stop	Stop Number: 46	1st & Baker
Bus Stop	Stop Number: 906	Ford & Mechanicsville
Bus Stop	Stop Number: 1724	Mechanicsville & Fairfield
Bus Stop	Stop Number: 1723	Mechanicsville & Carver
Bus Stop	Stop Number: 1726	Mechanicsville & Phaup
Bus Stop	Stop Number: 699	Chamberlayne & Mitchell
Bus Stop	Stop Number: 676	Chamberlayne & Bacon
Bus Stop	Stop Number: 703	Chamberlayne & Overbrook
Bus Stop	Stop Number: 702	Chamberlayne & Overbrook
Bus Stop	Stop Number: 1955	North & Overbrook
Bus Stop	Stop Number: 1935	North & E Lancaster

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Infrastructure Type	Name	Address
Bus Stop	Stop Number: 1952	North & Norwood
Bus Stop	Stop Number: 1953	North & Norwood
Bus Stop	Stop Number: 691	Chamberlayne & Hammond
Bus Stop	Stop Number: 685	Chamberlayne & Edgehill
Bus Stop	Stop Number: 690	Chamberlayne & Hammond
Bus Stop	Stop Number: 675	Chamberlayne approx 50 feet south of Edgehill
Bus Stop	Stop Number: 43	1st & Front
Bus Stop	Stop Number: 1712	Meadowbridge & Arnold
Bus Stop	Stop Number: 1715	Meadowbridge & Craigie
Bus Stop	Stop Number: 1718	Meadowbridge & Highlandview
Bus Stop	Stop Number: 1711	Meadowbridge & 2nd
Bus Stop	Stop Number: 1713	Meadowbridge & Bancroft
Bus Stop	Stop Number: 1716	Meadowbridge & Gladstone
Bus Stop	Stop Number: 1720	Meadowbridge & Northside
Bus Stop	Stop Number: 790	Corbin & North
Bus Stop	Stop Number: 1840	Moss Side & Akron
Bus Stop	Stop Number: 1845	Moss Side & Rex
Bus Stop	Stop Number: 791	Corbin & Rex
Car Wash	Shell	2000 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	R&J BUSINESS LLC	6 Jefferson Davis Hwy, Richmond, VA, 23224
Convenience Grocery Store	EKRA VENTURES INC	2905 Nine Mile Rd, Richmond, VA, 23223
Convenience Grocery Store	BLUE NINE MARKET INC	16 E Broad St, Richmond, VA, 23219
Convenience Grocery Store	BROADWAY MARKET PLACE VA CORP	312 E Broad St, Richmond, VA, 23219
Convenience Grocery Store	JORDAN BROTHERS INC	301 W Grace St, Richmond, VA, 23220
Convenience Grocery Store	MAHMOUD SARSOUR	422 W Broad St, Richmond, VA, 23220
Convenience Grocery Store	HMA LLC	18 W Baker St, Richmond, VA, 23220
Convenience Grocery Store	STOP & GO INC	1600 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	A & L CORPORATION OF VIRGINIA INC	1627 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	MARWA INC	1601 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	JAMAL ENTERPRISES INC	1912 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	RISHIKA INC	2001 Mechanicsville Tpke, Richmond, VA, 23223
Convenience Grocery Store	SATYAM 2 LLC	1501 Chamberlayne Ave, Richmond, VA, 23222

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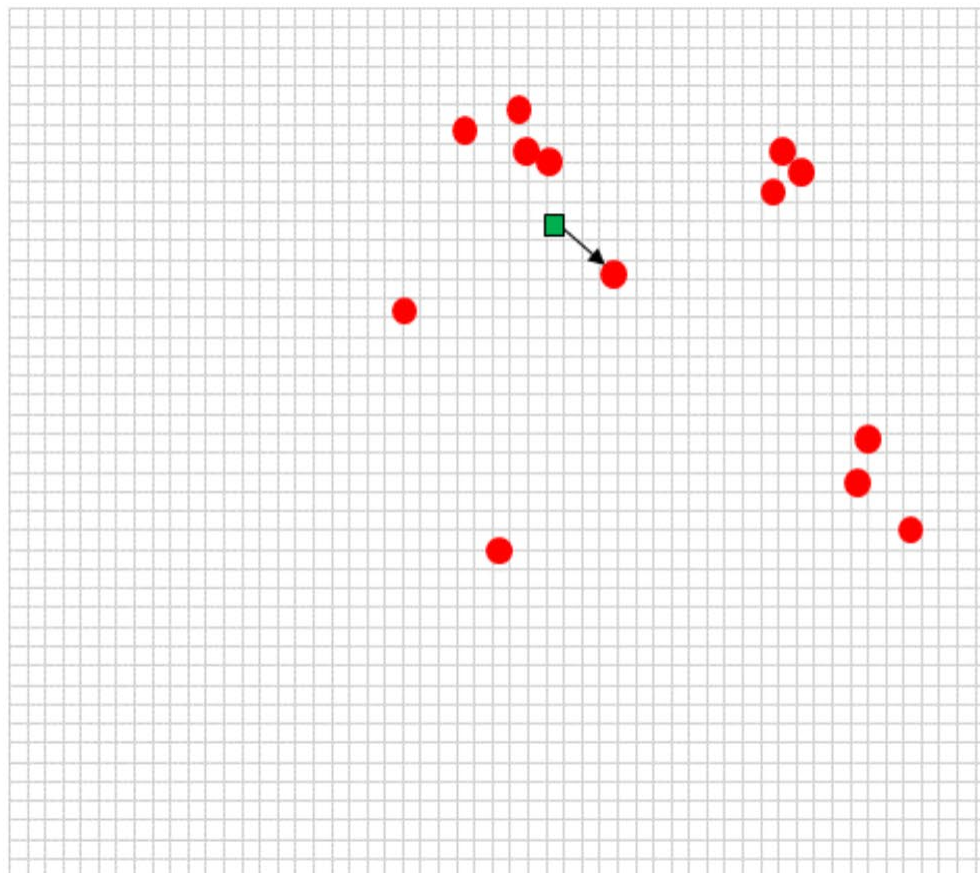
Infrastructure Type	Name	Address
Convenience Grocery Store	SAHARA INVESTMENT INC	2607 Chamberlayne Ave, Richmond, VA, 23222
Convenience Grocery Store	ELAAL LLC	3061 Meadowbridge Rd, Richmond, VA, 23222
Gas Station	BP	1636 Commerce Rd, Richmond, VA, 23224
Gas Station	BP	6 Jefferson Davis Hwy, Richmond, VA, 23224
Gas Station	BP	1800 Hull St, Richmond, VA, 23224
Gas Station	Stop-N-Go	1600 Mechanicsville Tpke, Richmond, VA, 23223
Gas Station	BP	2000 Mechanicsville Tpke, Richmond, VA, 23223
Gas Station	Coolane Express	2001 Mechanicsville Tpke, Richmond, VA, 23223
Gas Station	Express Mart	1912 Mechanicsville Tpke, Richmond, VA, 23223
Gas Station	Exxon	2607 Chamberlayne Ave, Richmond, VA, 23222
Gas Station	Express Mart	3100 Carolina Ave, Richmond, VA, 23222
Laundromats	Bank's Jr Dry Cleaners & Coin	419 Brook Rd, Richmond, VA, 23220
Motels	City Motel	3015 Jefferson Davis Hwy, Richmond, VA, 23234
Motels	Richmond Motel	2600 Chamberlayne Ave, Richmond, VA, 23222
Nail and Hair Salons	Harvey's Progressive Barber Shops	22 E Broad St, Richmond, VA, 23219
Nail and Hair Salons	425 Nail Bar & Pedi Lounge	425 W Broad St, Richmond, VA, 23220
Nail and Hair Salons	Ancient Techniques Salon	104 W Broad St, Richmond, VA, 23220
Pawnbrokers	Friedman's Loan Office Inc.	118 E Broad St, Richmond, VA, 23219
Payday Loan	Cash-2-U Payday Loans	2501 Chamberlayne Ave, Richmond, VA, 23222
Payday Loan	Quik Cash	2706 Chamberlayne Ave, Richmond, VA, 23222
Restaurant	CASL CORP	101 E 18th St, Richmond, VA, 23224
Restaurant	BUY THE POUND INC	111 E Grace St, Richmond, VA, 23219
Restaurant	JKOGI LLC	325 N 2nd St, Richmond, VA, 23219
Restaurant	MERROIR RVA LLC	320 E Grace St, Richmond, VA, 23219
Restaurant	MONROVIA LLC	404 N 2nd St, Richmond, VA, 23219
Restaurant	FIGHTING FISH LLC	317 N 2nd St, Richmond, VA, 23219
Restaurant	TARRANTS LLC	1 W Broad St, Richmond, VA, 23220
Restaurant	GENESIS PROJECT LLC	308 E Grace St, Richmond, VA, 23219
Restaurant	ARAMARK SPORTS & ENTERTAINMENT SERVICES LLC	403 N 3rd St, Richmond, VA, 23219
Restaurant	GRAFFIATO RVA LLC	123 W Broad St, Richmond, VA, 23220
Restaurant	J C G LLC	200 W Broad St, Richmond, VA, 23220
Restaurant	THE LIFT COFFEE SHOP LLC	218 W Broad St, Richmond, VA, 23220

Appendix B: References

Methodology Write-up

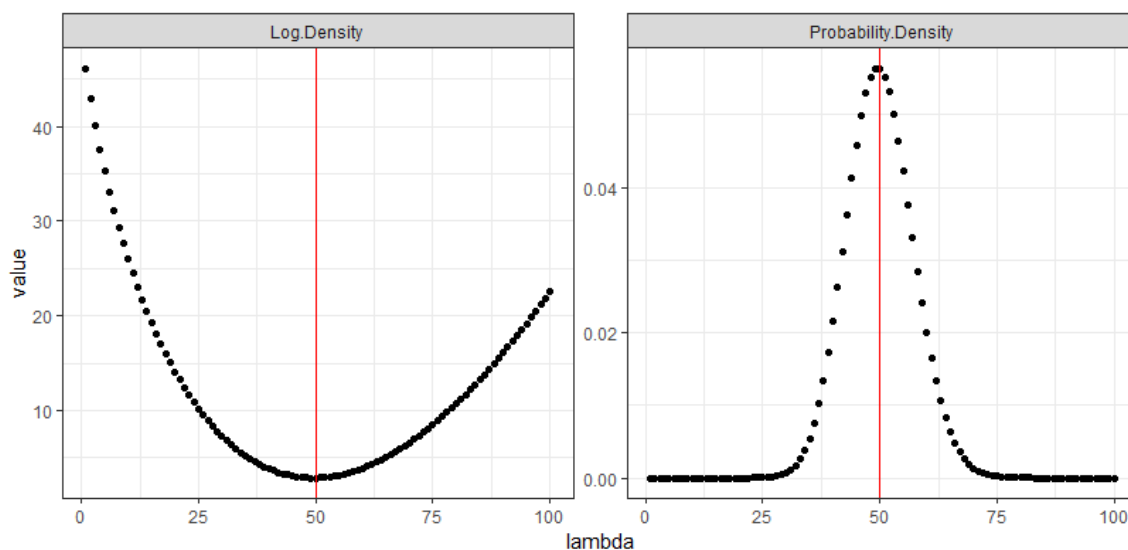
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9. The first approach illustrated the right image in this figure, measures the distance from each grid cell to its one nearest neighbor risk/protective factor. This relative measure of exposure is more useful than a simple aggregate count of risk/protective factors, however, it may be biased if the one nearest neighbor is an outlier. Thus, as illustrated by the left image in this figure, our third approach is to measure the average distance from each grid cell to its n nearest neighbor risk/protective factor, in this case n = 3. How many nearest neighbors is the 'correct' number to use? Consider the following three notions: First, for a given risk/protective factor, the 'correct' number of nearest neighbors leads to the best prediction. An optimal (but computationally intensive) predictive algorithm is one that would iteratively test each combination of risk/protective factors by each combination of n, selecting those the combination which leads to the most optimal model. Second, assumptions about n can be made according to how rare a given risk/protective event occurs in space. For instance, a feature describing exposure to crime would likely have a higher n than a feature describing distance to the nearest school. This is because crime occurs more frequently. Finally, if the scale of phenomena varies across the study area, there is likely no

one correct nearest neighbor parameter. For example, imagine a city composed of a dense downtown and a less dense neighborhood along the periphery. Despite being in the same jurisdiction, the scale of the social relationships occurring in each place are fundamentally different because the scale of the built environment is fundamentally different. The figure provides an example of all three feature engineering approaches.



10. The final step in the feature engineering phase is to normalize the contributing risk and protective features by putting all of the measurements onto a relative scale. Data are normalized in two steps: 1) centering the range of measurements for each feature on zero by subtracting the mean, and 2) by scaling the measurements of each feature by dividing by the measurements standard deviation. The end result is that each feature has a mean of zero and each value is a z-score. A primary benefit of putting each of the measurements on the same scale is to help the machine learning algorithms compute more efficiently. Additionally, it leads to scaled model coefficients that are relative to the average measurement of the feature.
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17. There 148 neighborhoods in Richmond. With each taking a turn as a hold out, there are 296 models calculated for the GLM and Random Forest models. As explained above, the Spatial Durbin model is estimated once, as the spatial weights matrix prevents LOGOCV approach. This yields a total of 297 models.
18. For example, if the predicted number of events is 5 and the observed number of recorded events is 7, then the MAE is 2. The absolute part describes that the error is the same whether it is positive or negative. The same prediction of 5 events and an observed value of 3 also has an MAE of 2. The MAE returns a single value no matter how many estimates are made. If the predictions for three different fishnet cells is 5, 8, and 10 with corresponding observed values of 3, 9, and 12, then the absolute errors are 2, 1, and 2 leading to an MAE of 1.67.
19. The graph below gives an example of how the log density and probability density measurements of the Logarithmic Score relate. In this plot, the two measurements are calculated for the same scenario in which the predicted value of maltreatment events is 50 (at the red vertical line) and the observed number of events is represented by each of the black dots from zero to 100. At the left hand side of each is the case where the recorded number of events is zero or close to zero. At this location the log density is very high relative to the baseline of zero and the probability density is near zero. In the middle of each chart where the estimated and expected values are close to the same, the log density is near zero and the probability is at its maximum. As the observed values move to the right away from the estimate, the log density again goes up and the probability goes down. The important takeaway from this plot is that when measured as a log density, the best estimate is always the one closest to zero which makes it very easy to compare models. However, the scale of the log density is not very intuitive. On the other hand, measuring on the probability side can lead to difficulties in comparing models if they are fit to different sets of data. However, it is on an intuitive scale of probability between zero and one. Given that all of the models here are fit to the same dataset, the probability density measurement is selected to represent the Logarithmic Score.



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Variables Summary Description

Conceptualization of Crime Indicators as Spatial Risk Factors for Child Maltreatment

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Weapon Summary — Child Injury Indicators as Risk Factors for Child Maltreatment

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Appendix C: Align Phase GIS Workflow

The purpose of the Align and Prevent phases is to utilize the predictions generated from the predictive algorithm in the context of strategic planning. Specifically, the goal is to understand the extent to which the supply of child welfare services are properly aligned with the demand for child welfare services.

We use a variety of administrative datasets to define the *supply* of child welfare services. To define *demand*, we employ the risk predictions estimated from the model.

The goal of this tutorial is to port the Align phase from R code into an ArcGIS tutorial, making it more accessible to GIS analysts. The following workflow identifies protective land uses that are optimally located relative to maltreatment risk. Protective land uses are locations of existing resources that can aid the community in combating child maltreatment, such as churches and community centers. Stakeholders may wish to deploy additional education, treatment, or prevention resources in these places. Through this workflow, we are also able to pinpoint areas that are at risk for maltreatment but are currently under-served by these Protective land uses.

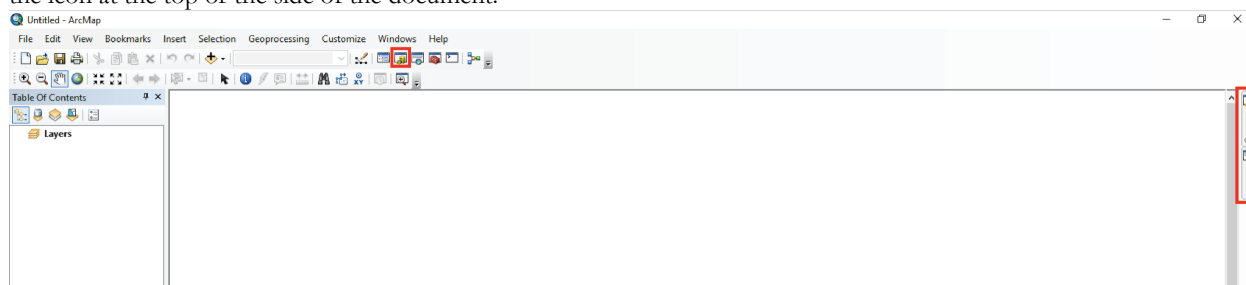
We report several analytics including:

1. Assigning predicted risk categories to protective land uses
2. The mean predicted count of maltreatment events within a quarter mile of a protected resource
3. How resources are distributed across risk categories
4. Risk category population totals
5. The mean poverty rate per risk category


These analyses can be performed in ArcGIS by using location data on a variety of resources, such as home visits, churches, and community centers, and a shapefile of the risk predictions. Below we provide step-by-step instructions for each of the five analytics. While we show each analytic using a single example, they can easily be reproduced with other supply-side oriented datasets.

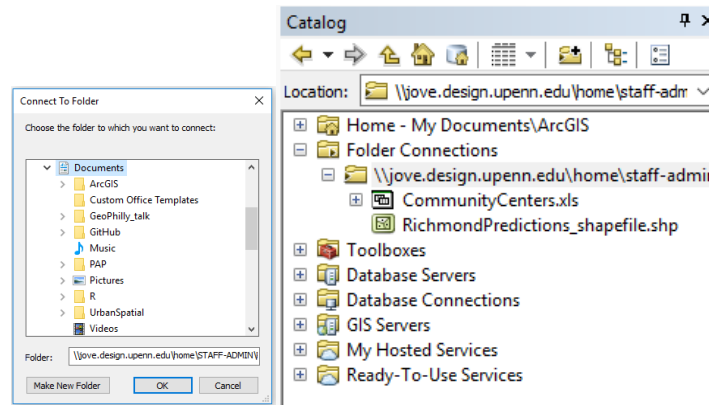
Bringing Data Into Arcmap and Preparing Data

Before we begin any analyses, we need to set up our ArcMap document and prepare the data. After opening a blank document in ArcMap, we need to add bring the data in. We can open ArcCatalog directly in ArcMap by either clicking on the icon at the top or the side of the document.



You can “pin” ArcCatalog to the side by clicking the pin icon  at the top of the panel.

In the ArcCatalog side panel there is an add folder connection icon . Click on this icon and a navigation pane will appear. Navigate to the folder where you are keeping the data. Click **OK** and the folder will appear under **Folder Connections** in the ArcCatalog side panel. *NOTE: It is important that none of your folders or data are named with spaces. If the names of any data have spaces in them, please take the time to rename them now.*



Now we can easily add datasets to ArcMap by dragging the data from the ArcCatalog side panel into the **Table of Contents**. The first dataset you bring in will prime the document's coordinate system. We recommend bringing in the shapefile of the risk predictions first. To view what coordinate system the shapefile is in: **Right click on the layer > Properties > Source**.

At this point, we recommend saving the document (and saving frequently).

1. Assigning Predicted Risk Categories to Protective Land Uses

First, **bring in the shapefile of the risk predictions** (we will refer to it as the *Risk Prediction Shapefile* throughout the tutorial). **Right click on the Risk Prediction Shapefile > open attribute table**. You will notice that there are three important fields: *pred*, *pred_cat*, and *kde_cat*.

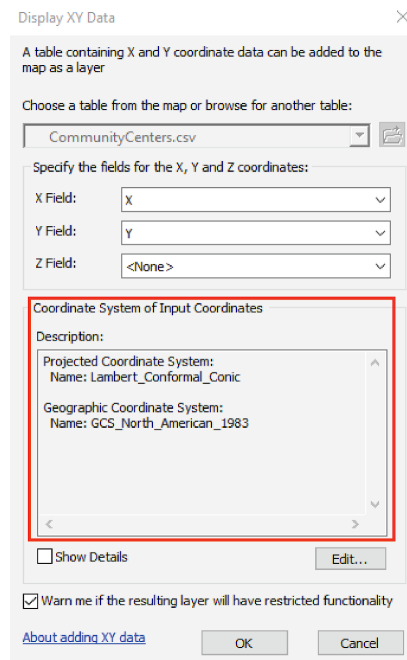
pred is the predicted count of maltreatment events for that grid cell.


pred_cat is the predicted risk category that grid cell falls in based on the final predictive algorithm.

kde_cat is the risk category that grid cell falls in based on a Kernel Density Estimation (KDE). KDE is a common tool to convert point data into hot spot maps, which makes it a useful baseline to compare the model predictions to.

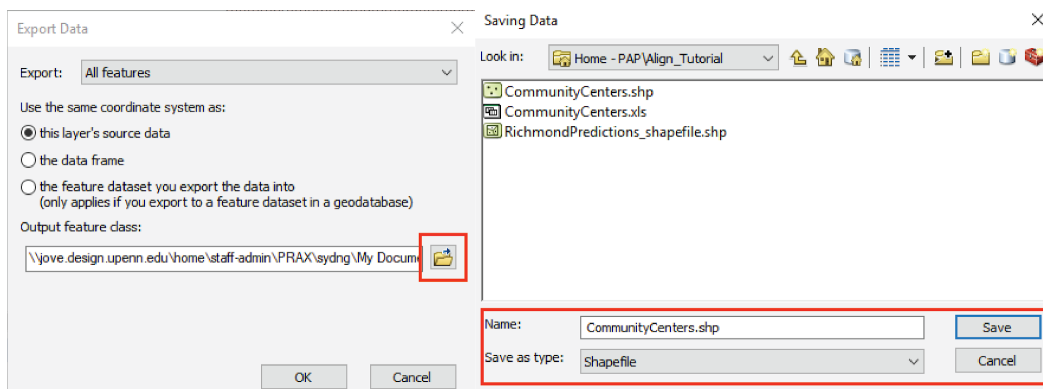
Next, we can bring in data on protective land uses. Here we use community centers as an example, but this analysis can be repeated using a variety of of supply-side oriented datasets. Currently the data is formatted as a spreadsheet. Drag the CSV into the TOC. **Right Click > Open** to view the table and its fields. We will add this data to the map as points using X/Y coordinates.

Right click on the layer > Display XY Data. This will open a dialogue box. You will notice that the coordinate system was automatically filled as the same one as the *Risk Prediction Shapefile*. Click **OK** and the data will be added to the TOC as an "event".



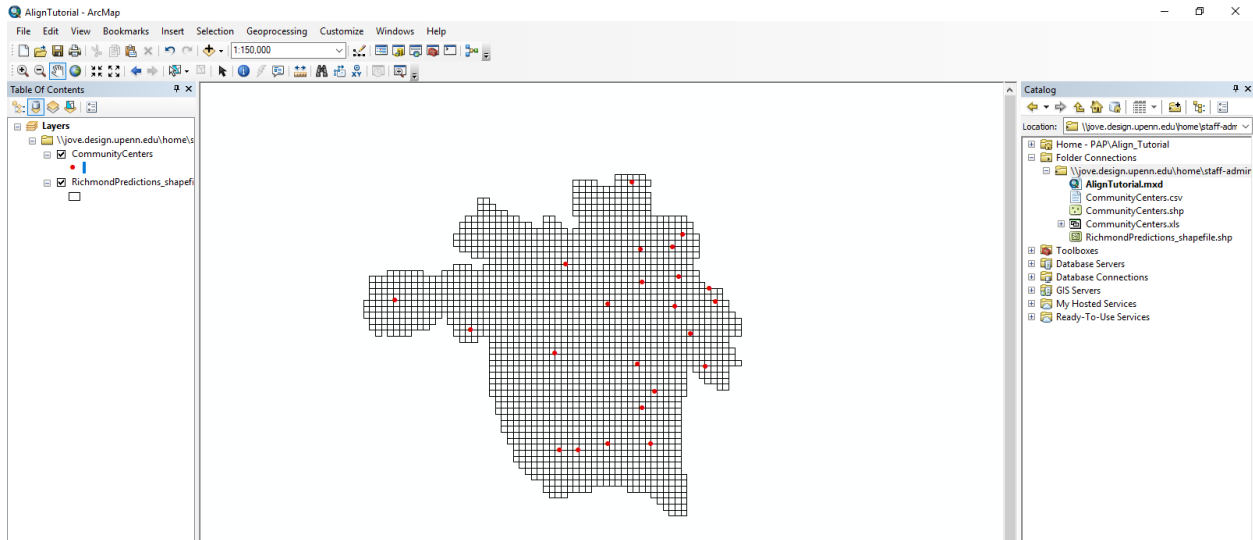
NOTE: Depending on the data source, X and Y coordinates may be reversed. When you add the data, it does not appear in the same extent as the Risk Prediction Shapefile click the globe icon  at the top of the document. This will zoom out for you to see the full extent. If the points are in a completely different place, switch the coordinates around in the dialogue box above.

Export the data as a shapefile before proceeding with the analysis. To do this, **Right click on the layer > Data > Export Data**. Save it as *CommunityCenters*. In the dialogue box that appears, use the folder icon to name the shapefile what you wish. Make sure to save it as a **shapefile**. When prompted if you want to add the shapefile to map, say **yes**.



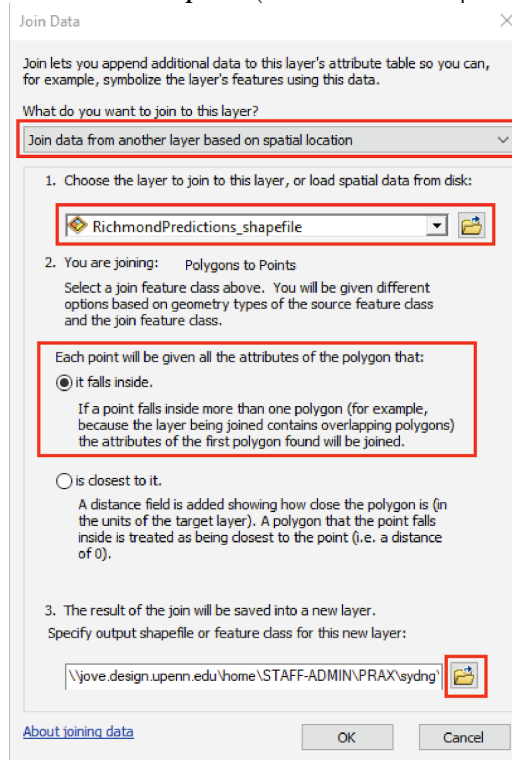
Now that the community centers are formatted as a shapefile, we can remove the events and CSV from the TOC by **right clicking > Remove**.

At this point, we should have something like this (the fishnet with a set of points on top of it):



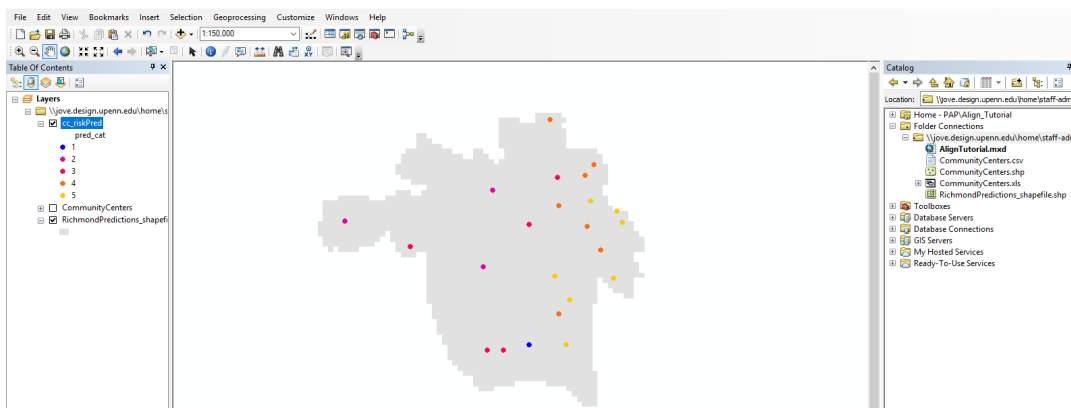
We will spatial join the points and the fishnet to assign the risk category the points are in to the community centers. ***This will inform whether these protective resources are in areas predicted as high or low risk for child maltreatment.***

Right click on **CommunityCenters** > **Joins and Relates** > **Join**. This will bring up a dialogue box. From the drop down menu at the top choose **join data from another layer based on spatial location**. For 1) choose the *Risk Prediction Shapefile*. For 2) each point will be given the attributes of the polygon that **it falls inside**. For 3) use the folder icon to save the result as *cc_riskPred*. Make sure to save it as a **shapefile** (like earlier when exporting data).



Right click on **cc_riskPred** > **Open Attribute Table**. Scroll to the end and you will see the fields added from the fishnet.

To visualize the risk scores for each community center: **Right click on cc_riskPred > Properties > Symbology > Categories > Unique Values.** For *Value Field* choose the prediction categories. Click **Add All Values** button towards the bottom of the dialogue box. Choose the color ramp you prefer. Right click on **Symbol > Flip Symbols** to make the lightest color the highest risk category. Click **OK**.



We can now see which community centers are optimally located in areas with predicted high risk of child maltreatment.

2. The Mean Predicted Count of Maltreatment Events Within a Quarter Mile of a Protected Resource

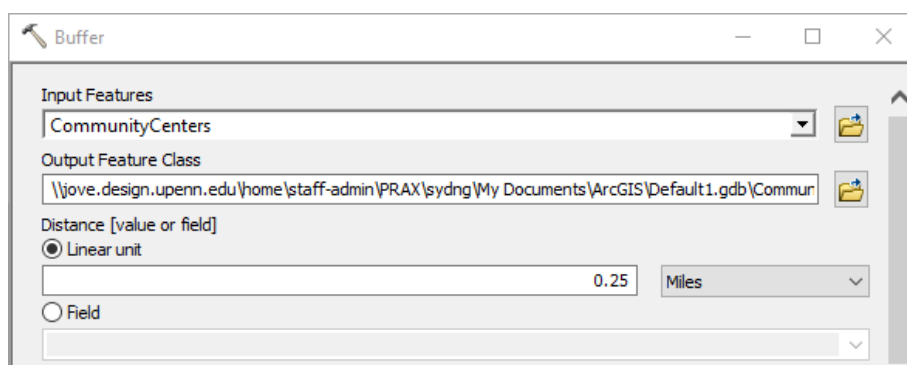
This analytic will give insight into the mean predicted count of child maltreatment within walking distance ($\frac{1}{4}$ mile) of a protective feature.


We will begin by buffering the *CommunityCenters* shapefile by a quarter mile. At the top of ArcMap click **Geoprocessing > Buffer**. This will open a dialogue box, which you should populate as follows:

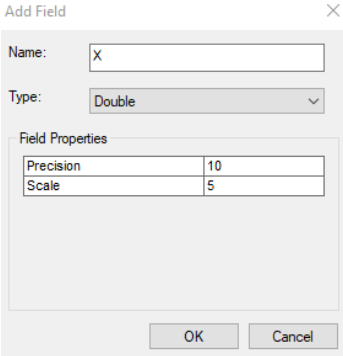
Input Feature: **CommunityCenters**

Output Feature Class: use folder icon to save as **cc_buffer**

Linear Unit: choose **Miles** from the dropdown and enter **0.25** in the field.



Next, transform the fishnet grid into centroid points. **Right click on the Risk Prediction Shapefile > Open Attribute Table.** Under the table options drop down  in the top left corner choose **Add Field**. Populate the dialogue box as shown below:



Add Field

Name: X

Type: Double

Field Properties

Precision	10
Scale	5

OK Cancel

Click **OK**. Repeat this process, except with the *Name Y*.

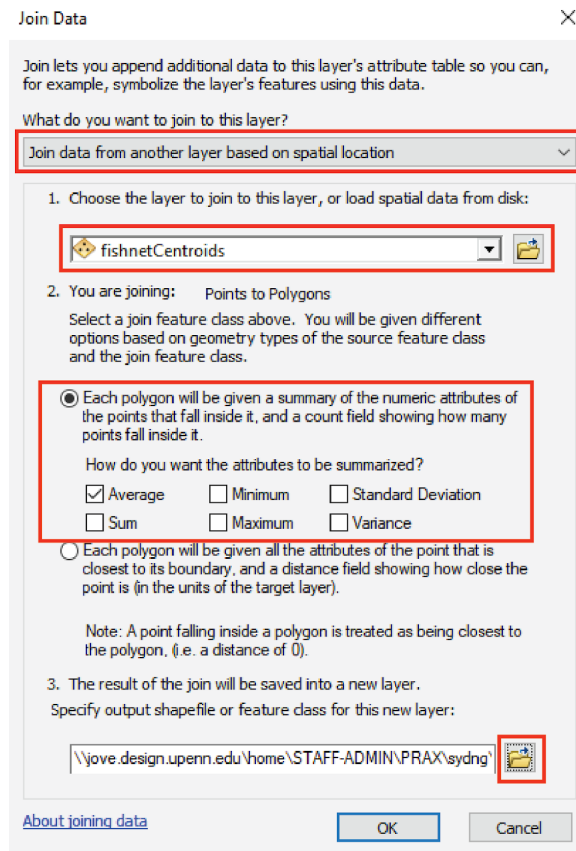
Right click on the field X > Calculate Geometry (if a box pops up click “yes”). Under the *Property* drop-down choose **X Coordinate of Centroid**. Repeat this process for the *Y* field, except select **Y Coordinate of Centroid** from the drop-down menu.

We will also calculate the area of the fishnet grid cells. This information will be used for two analyses below. **Add a field.** Name: *fish_acres*, Type: *Float*, Precision: 10, Scale: 5. **Right click on fish_acres > Calculate Geometry**. Under the Property drop-down select *Area* and choose **acres** as the *Unit*.

Under the table options drop-down click **Export**. Save the table, *riskTable*, as a **dBASE Table**. Add it to the map. **Follow the same Display XY Data steps from above.**

NOTE: when saving as a dBASE Table, make sure to add “.dbf” to the file names. If this is not included, an error will occur as a result of a bug with ArcGIS.

Right click on cc_buffer > Joins and Relates > Join. Join based on **spatial location**. For 1) Choose the fishnet centroids. For 2) summarize the attributes by taking the **average**. For 3) use the folder icon to save the result as *cc_buffer_meanRisk*.



Right click on `cc_buffer_meanRisk` > **Open Attribute Table**. Scroll to the end. There will be a field for average predicted count (in this case called *Avg_pred*).

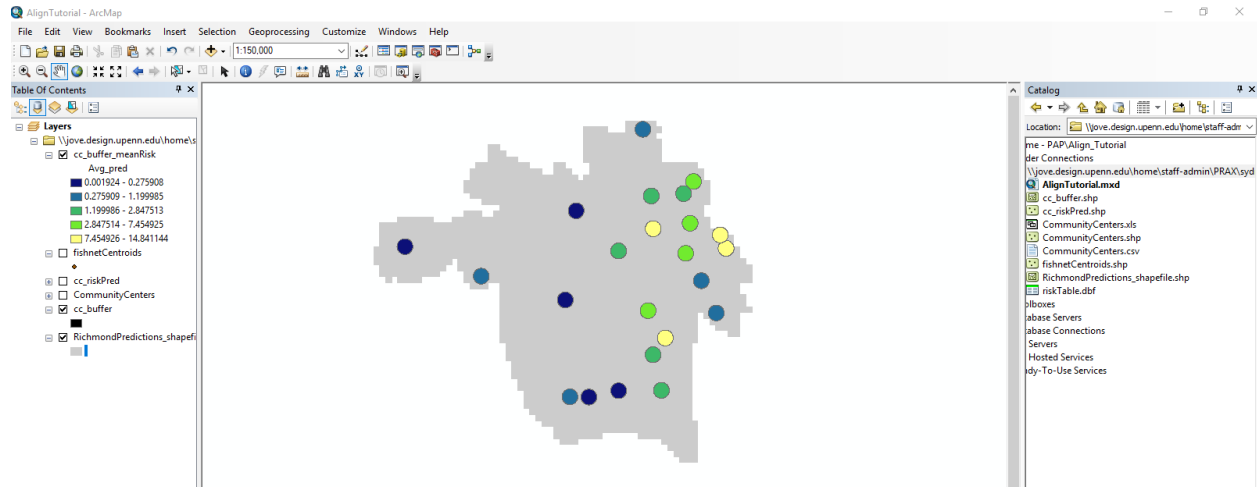
Table

cc_buffer_meanRisk

EditState	PointOf_1	PointOf_2	CenterEdit	CenterEd_1	X	Y	BUFF_DIST	ORIG_FID	Count	Avg_pred	Avg_pred_c	Avg_kde_ca
complete	rosewl	8/13/2007	rosewl	8/13/2007	11802205.14	3723681.28	1320	0	6	11.754073	4.666667	5
complete	rosewl	8/13/2007	waldrosr	6/3/2009	11792074.52	3708739.584	1320	1	7	9.139008	4.571429	3.857143
complete	rosewl	6/1/2007	waldrosr	6/3/2009	11777220.8	3729951.283	1320	2	5	0.038061	2.2	1
complete	georgeae	8/8/2007	waldrosr	6/5/2009	11800575.05	3712901.244	1320	3	4	1.106971	3	3.5
complete	rosewl	9/11/2014	waldrosr	6/5/2009	11784300.37	3723255.023	1320	4	6	1.408802	3.833333	3
complete	waldrosr	6/1/2009	waldrosr	6/1/2009	11790062.7	3726958.324	1320	5	6	12.460905	4	4.666667
complete	rosewl	7/23/2007	waldrosr	6/7/2009	11791434.82	3700003.798	1320	6	4	2.847513	3.75	3
complete	waldrosr	6/1/2009	waldrosr	6/1/2009	11798081.24	3718284.044	1320	7	6	1.199985	3.833333	5
complete	waldrosr	6/3/2009	waldrosr	6/3/2009	11776184.08	3698916.796	1320	8	6	0.813481	3.333333	3
needs research	waldrosr	6/5/2009	waldrosr	6/5/2009	11788347.72	3743537.379	1320	9	6	0.61842	3	2.5
complete	waldrosr	6/7/2009	waldrosr	6/7/2009	11796774.04	3734831.792	1320	10	5	3.289926	4.2	4
complete	rosewl	8/13/2007	waldrosr	6/3/2009	11795127.34	3732817.1	1320	11	6	2.526839	4.166667	5
complete	rosewl	9/17/2007	waldrosr	6/1/2009	11790046.66	3705942.387	1320	12	6	1.72956	4.166667	4
complete	waldrosr	6/7/2009	waldrosr	6/7/2009	11748899.68	3733079.073	1320	13	4	0.04164	2.25	1

We symbolize the data using this field. Right click on `cc_buffer_meanRisk` > **Properties** > **Symbology** > **Quantities** > **Graduated Colors**. For *Value* choose mean predicted count field. Choose the color ramp you want. Click the *Classify* button and choose **Quantile** as the *Method* with 5 classes. Flip the color ramp so the lightest color is associated with the highest values.

Now we can see what community centers are situated in areas with more predicted maltreatment events on average.



3. How Resources are Distributed Across Risk Categories

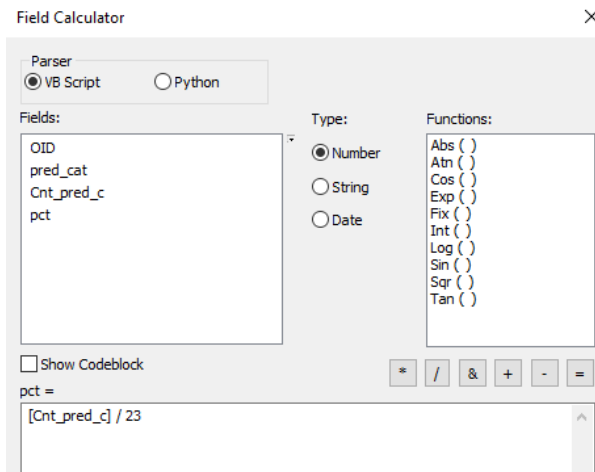
This third analysis helps quantify how resources are distributed across risk categories. Understanding how resources are distributed across risk categories is particularly helpful when looking at home removals or child fatalities, as this will inform how well current services are reaching populations in need. However, since that data is private, we will use community centers to show you the process.

We start with the **cc_riskPred** created by following the steps for the first analysis.

Right click on cc_riskPred > Open Attribute Table. Scroll until you find the field for predicted risk category. **Right click on the field > Summarize.** Save the table as a **dBASE table** and call it *cc_riskPred_summarize*. When prompted add the table to the map.

Right click on cc_riskPred_summarize > Open Attribute Table > Add a Field. Name it *pct* and make it type **float**. Set the precision to **10** and the Scale to **5**.

Right click on pct > Field Calculator. If a dialogue box pops up click **yes**. In the Field Calculator dialogue box, put in the following equation: $[\text{Count_pred_cat}] / 23$. Where *Count_pred_cat* is the number of community centers in each risk category (what we just summarized) and 23 is the total number of community centers (this can be found by right clicking *Count_pred_cat* and going to statistics and looking at the sum).



You can export this table from ArcMap and bring it into excel to create a bar chart showing the percent of community centers in each risk category. This process illustrates how aligned current supply of services are with need. If they are well aligned, we would see a large portion of services in the highest risk category.

4. Risk Category Population Totals

The next two analyses require downloading data and shapefiles from the Census Bureau. First, download the **2010 block groups for Richmond City** using the following link: <https://www.census.gov/cgi-bin/geo/shapefiles/index.php>.

Second, using [American Fact Finder](#) download the **total population for 2010** at the **Block Group** level for **Richmond City**. Before downloading the table, **transpose the rows/columns** so each row is block group. Select to download it as **a spreadsheet or database** to get a CSV (uncheck the boxes).

Extract all of the data and save it to the appropriate folder. Drag both into the map. We will be calculating the weighted population of Richmond City. This will distribute the population totals from the block groups to the fishnet cells and will provide insight into the demand for child welfare services in the risk categories.

Right click on the population table > Data > export as dBASE table (richmondBG_Pop10.dbf) > add to map.

Right click on richmondBG_Pop10 > Open > Add Field. Name: *GEOID10*, Type: *Text*

Right click on GEOID10 > Field Calculator. Set GEOID10 equal to GEO_id2.

Right click on Richmond City block groups > Joins and Relates > Join > Join attributes from a table. Select **GEOID10** as the field to join on and the **richmondBG_Pop10** as the table to join to. It should automatically fill in **GEOID10** as the field for 3. **Keep all records.**

Join Data

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?

Join attributes from a table

1. Choose the field in this layer that the join will be based on:

GEOID10

2. Choose the table to join to this layer, or load the table from disk:

richmondBG_Pop10

Show the attribute tables of layers in this list

3. Choose the field in the table to base the join on:

GEOID10

Join Options

Keep all records
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.

Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.

Validate Join

[About joining data](#) OK Cancel

As an option to clean up the table you can **right click on the block group shapefile > Properties > Fields** and turn off all fields except for GEOID10 and D001.

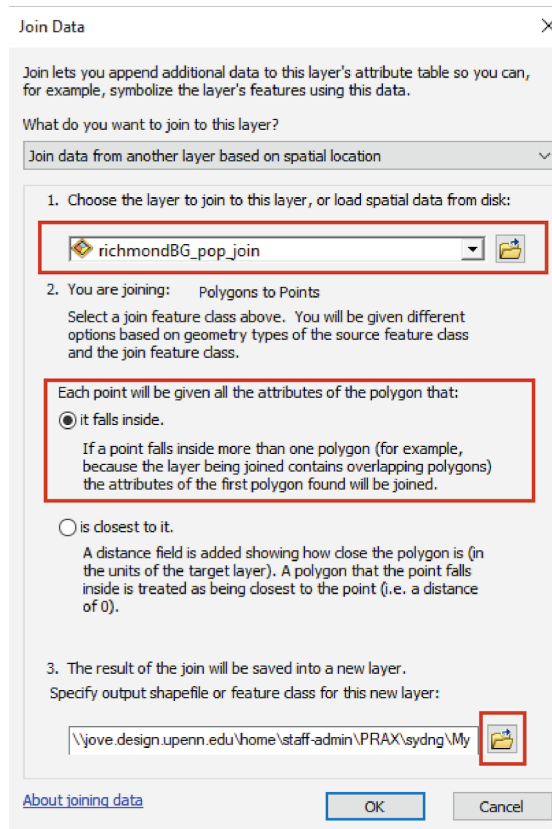
Right click on the block group shapefile > Data > Export data. Use the **data frame's** coordinate system and save the file as *richmondBG_pop_join*. Add the shapefile to the map.

Right click on richmondBG_pop_join > Open Attribute Table > Add Field. Name the field *Acres* and make it type float, with precision *10* and scale *5*.

Right click on Acres > Calculate Geometry. Choose **Area** from the drop down and **acres** for the unit.

Add a Field. Name it *pop_acre_r*. Again make it type float, with precision *10* and scale *5*. **Right click on pop_acre_r > Field Calculator > [D001] / [Acres]** (We recommend double clicking on the fields and using the operators ArcGIS provides in Field Calculator to do the calculations and avoid errors).

Using the **fishnetCentroids** shapefile created above, **right click on the centroids > Joins and Relates > Join > Join data from another layer based on spatial location.** Choose the **richmondBG_pop_join** shapefile and select that it **falls inside**. Save the result as **centroid_BG_join**.



Add a field called *pct_of_bg* using the same specifications as above. Right click on *pct_of_bg* > Field Calculator > [fish_acres] / [Acres]

Add a field called *int_pop* once again using the same specifications. Right click on *int_pop* > Field Calculator > [D001] * [pct_of_bg]

Right click on *int_pop* > sort ascending. This will bring all fishnet cells with a weighted population of zero to the top. Select the first observation. Scroll until you find the last observation with 0 for *int_pop*. Hold SHIFT and select that last observation. You should notice all of the grid cells are on the outskirts of the city limits. In an editing session you can remove these cells.

Right click on *pred_cat* > Summarize. For 2 in the dialogue box - scroll to the bottom. Expand the menu for *int_pop* and check Sum. Save the table as a dBASE Table and name it *weightedPop*. Add the table to the map.

Table

centroid_BG_join

FID	Shape *	FID_1	pred	pred_cat	kde_cat	X	Y	FID_2	GEOID10	D001	Acres	pop_acre_r	fish_acres	pct_of_bg	int_pop
0	Point	441	0.040434	2	4	11801000.6244	3716443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
1	Point	449	0.727883	4	5	11802000.6244	3718443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
2	Point	451	1.935019	4	5	11801000.6244	3719443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
3	Point	568	1.081379	4	5	11801000.6244	3721443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
4	Point	569	0.390135	3	5	11802000.6244	3721443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
5	Point	573	0.054026	3	5	11802000.6244	3722443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
6	Point	738	0.499025	4	5	11803000.6244	3722443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
7	Point	887	1.580034	4	4	11802000.6244	3716443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
8	Point	1369	0.208172	3	5	11803000.6244	3718443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
9	Point	1370	0.03079	2	5	11804000.6244	3718443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
10	Point	1371	6.104684	5	5	11802000.6244	3719443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255
11	Point	1372	5.576855	5	5	11803000.6244	3719443.78132	0	517600209001	1060	545.328863	1.943781	22.956933	0.042097	44.623255

Summarize

Summarize creates a new table containing one record for each unique value of the selected field, along with statistics summarizing any of the other fields.

1. Select a field to summarize:
pred_cat

2. Choose one or more summary statistics to be included in the output table:
pop_acre_r
fish_acres
pct_of_bg
int_pop
Minimum
Maximum
Average
Sum
Standard Deviation
Variance

3. Specify output table:
\\jove.design.upenn.edu\home\staff-admin\PRAX\sydng'

Summarize on the selected records only

[About summarizing data](#) OK Cancel

From this table, we can now understand how many people live in each risk category and the potential demand in high risk areas for child welfare services.

5. The Mean Poverty Rate per Risk Category

We now want to understand the type of person living in the highest risk category. To do so, we will look at weighted poverty rate by risk category, however, these same steps can be used to look at other demographic characteristics. This analysis will be similar to looking at population.

Begin by downloading **2010 Census Tracts for Richmond City** from [here](#) and **2010 Poverty Status (B17001) for Richmond City Census Tracts** from [American Fact Finder](#).

Extract the data. Open the CSV in excel. Clean up the file. We are interested in the total number of people in poverty (HD01_VD01). Delete all fields except **HD01_VD01**, **GEO.display-label**, **GEO.id2**, and **GEO.id**. Rename HD01_VD01 to be *TotalPov*. Save the CSV.

Add the files to the map.

Right click on the poverty table > Data > export as dBASE table (richmondCT_Pov10.dbf) > add to map.

Right click on richmondCT_Pov10 > Open > Add Field. Name: *GEOID10*, Type: *Text*

Right click on GEOID10 > Field Calculator. Set GEOID10 equal to GEO_id2.

Right click on Richmond City census tracts > Joins and Relates > Join > Join attributes from a table. Select **GEOID10** as the field to join on and **richmondCT_Pov10** as the table to join to. It should automatically fill in **GEOID10** as the field for 3. **Keep all records.**

Join Data

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?
Join attributes from a table

1. Choose the field in this layer that the join will be based on:
GEOID10

2. Choose the table to join to this layer, or load the table from disk:
richmondCT_Pov10
 Show the attribute tables of layers in this list

3. Choose the field in the table to base the join on:
GEOID10

Join Options
 Keep all records
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.
 Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.

Validate Join

About joining data

OK Cancel

At this point, you can **right click on the census tract shapefile > Properties > Fields** turn off all fields except for GEOID10 and TotalPov.

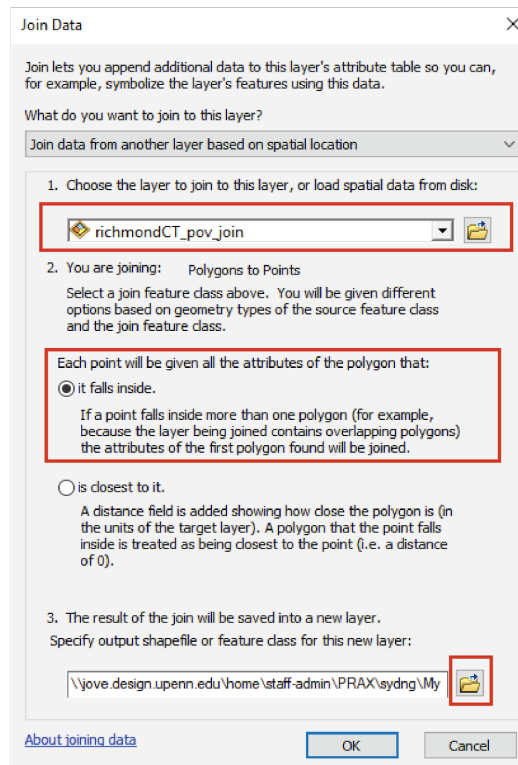
Right click on the census tract shapefile > Data > export. Use the data frame's coordinate system and save the file as *richmondCT_pov_join*. Add the shapefile to the map.

Right click on richmondCT_pov_join > Open Attribute Table > Add Field. Name the field *CT_Acres* and make it type *Float*, with precision *10* and scale *5*.

Right click on Acres > Calculate Geometry. Choose **Area** from the drop down and **acres** for the unit.

Add a Field. Name it *pov_acre_r*. Again make it type *Float*, with precision *10* and scale *5*. **Right click on pov_acre_r > Field Calculator > [TotalPov] / [Acres].**

Right click on centroid_BG_join > Joins and Relates > Join > Join data from another layer based on spatial location. Choose the *richmondCT_pov_join* shapefile and select that it **falls inside**. Save the result as *centroid_CT_BG_join*.



Right click on centroid_CT_BG_join > Open Attribute Table. Add a field called *pct_of_ct* using the same specifications as above. Right click on *pct_of_ct* > Field Calculator > [fish_acres] / [CT_Acres]

Add a field called *int_pov* once again using the same specifications. Right click on *int_pov* > Field Calculator > [TotalPov] * [pct_of_ct]

Add a Field. Name it *pov_rate* and use the same specifications. Right click on *pov_rate* > Field Calculator > [int_pov] / [int_pop]

Right click on *pred_cat* > Summarize. For 2 in the dialogue box - scroll to the bottom. Expand the menu for *pov_rate* and **check Average**. Expand the menu for *int_pov* and **check Sum**. Save the table as a **dBASE Table** and name it *weightedPoverty*. Add the table to the map.

Now we can understand the average poverty rate and number of people living in poverty in each risk category. These metrics provide insight into the type of people who may potentially have higher need for child welfare services.