USING PREDICTIVE RISK MODELING TO
Prioritize Services for People Experiencing Homelessness in Allegheny County
Methodology Paper for the Allegheny Housing Assessment

SEPTEMBER 2020

Introduction

In 2014, as a result of a successful [Request for Proposals](#) (RFP) process, the Allegheny County [PA] Department of Human Services (DHS) entered into a research partnership with the Centre for Social Data Analytics at the Auckland University of Technology to explore the use of decision support tools and predictive analytics in human services. One such exploration focused on the possibility of replacing the existing approach to triaging homeless services with a Predictive Risk Model (PRM) that would standardize the assessment process and improve the accuracy of program referrals and admissions. In August 2020, the Allegheny Housing Assessment (AHA) was launched. This report outlines the background to the implementation and technical details on how the model was built and deployed.

We ask the reader to bear two considerations in mind while reviewing this report and the methodology/implementation of the AHA. The first consideration relates to our interest in ongoing review and transparency of the work. The information contained in this report is preliminary and based on a model that has been and continues to be revised as we learn more about the impact of the PRM and the business processes of the AHA. We are working with the County and with partners to fine tune the model over the next several months. The outside evaluation, for which the County plans to issue a solicitation in 2021, will also inform modifications of the model.

The second consideration relates to the onset and impact of the COVID-19 pandemic. While the Allegheny Link (which operates Allegheny County's coordinated entry system for homelessness services) and the County's Continuum of Care (CoC) providers have continued business as usual, there is no question that the health, economic and social impacts of the past several months have changed use of many County services and this is expected to impact the data and some features of the model. For example, jail bookings and emergency room visits have declined during the crisis, and so predictors that used recent interactions with these systems will be lower than what they were at the time that the research data set was extracted and the models were built. The ongoing economic downturn is expected to get worse and high levels of unemployment are forecasted. As such, we anticipate high demand for homelessness services, as well as a change in the characteristics of the homeless population (e.g., families that always lived from paycheck-to-paycheck without a cushion will be at high risk of homelessness, particularly as rent and mortgage moratoria expire). As we consider the implications and potentially make changes to the way in which the AHA is constructed and used during the pandemic, we will update and revise this paper to reflect those changes.

Background

DHS, through its network of service providers across the County, provides a Continuum of Care (CoC),[1] a range of services for individuals and families at risk of or experiencing homelessness. Services include eviction prevention assistance, landlord mediation, rental

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[1] DHS is designated as Allegheny County's homeless Continuum of Care (CoC) lead agency and as the collaborative applicant for funding through the U.S. Department of Housing and Urban Development (HUD). In this role, DHS staffs and facilitates the coordinated entry system, which, as required by HUD, is designed to assess individuals/families and determine their priority ranking for long term housing.

and utility assistance, case management and other supportive services, street outreach, emergency shelter services and longer-term housing programs including bridge/transitional housing, rapid rehousing (RRH) and permanent supportive housing (PSH).

The number of available long-term housing beds or units fluctuates throughout the year as newly funded programs begin, others close and/or seasonal shelters open. As of January 2020, Allegheny County had 212 bridge housing beds, 939 RRH beds and 1810 PSH beds. Some of these beds are targeted for families with minor children, some are reserved for veterans and some are for youth ages 18 through 24. Overall, the number of housing beds/units is insufficient for the number of people who are experiencing homelessness and meet the U.S. Department of Housing and Urban Development's (HUD) eligibility criteria for long term housing support.

The Allegheny Housing Assessment (AHA) will be utilized to better describe the impacts of unmet housing needs and support the prioritization of people for bridge/transitional housing, RRH and PSH. Because clients can stay in these programs for a long time, only a fraction of these units become available through turnover in any given year. In 2019, about 800 of these housing units became available through turnover as households exited these programs (approximately 200 families and 600 singles), according to household exit records in the County's homeless management information system (HMIS). In 2019, more than 2,000 households (approximately 600 families and 1450 singles) experiencing homelessness and determined to be eligible for PSH, RRH or bridge/transitional housing received a risk assessment through the coordinated entry system. Thus, last year, a housing gap of approximately 1200 units existed and the County could serve less than half of the households (singles and families) that were assessed. This highlights the importance of appropriately prioritizing the most vulnerable households for these limited services.

Table 1 provides insight into the supply and demand of PSH, RRH and bridge/transitional housing units as well as a snapshot of the monthly waiting list of households that have been assessed and are eligible for a housing referral when a unit becomes available. For single households,76% of RRH units (205/270), and 21% of PSH units (152/729) became available in 2019 due to the turnover of households exiting programs. Single bridge/transitional housing units had higher turnover in 2019, with approximately 215 households exiting the roughly 140 units available throughout the year. For households with children (families) in 2019, 57% of RRH units (89/157), 31% of PSH units (121/386) and 17% (1/6) of bridge/transitional housing units became available through turnover throughout the year.

Table 1: Counts of availability and demand for funded units in PSH and RRH

Household Type	Service Type	Funded Units in 2019	Average Units Available per Month (became available due to program turnover)	Point-in-time snapshot of housing waitlist (July 2019)	Subset of waitlist identified as chronically homeless
Singles	Rapid Re-Housing	270	17	369	85
	Permanent Supportive Housing	729	13		
	Bridge/Transitional Housing	139	18		
Families	Rapid Re-Housing	157	7	86	12
	Permanent Supportive Housing	386	10		
	Bridge/Transitional Housing	6	<1		

Note: Counts for families represent housing units and household counts and not the number of beds or individuals; a family unit will contain multiple beds and persons, depending on the size of the household.

Whereas all individuals and families experiencing homelessness are eligible for emergency shelter services, RRH, PSH and bridge/transitional housing programs require clients to meet

eligibility thresholds and be assigned priority status on the waiting list. Table 2 describes the eligibility rule for each type of housing program.

Table 2: Homeless Services Type and Eligibility Rules

Service Type	Program Description	Eligibility
Emergency Shelter	A facility with overnight sleeping accommodation, the primary purpose of which is to provide temporary shelter. People utilizing emergency shelters are considered to be homeless. This category includes both family and single shelters.	Self-assessed as currently homeless
Street Outreach	A service assisting people living on the streets or other places not meant for human habitation. People are engaged by street outreach workers to provide basic needs (food/water/medical care) as well as to connect them to housing services and other supportive services (behavioral health, etc.).	Identification by street outreach workers as living in a place not meant for human habitation
Bridge/Transitional Housing	A program designed to provide housing and appropriate supportive services to homeless people to facilitate movement to independent living within a reasonable amount of time, but less than 24 months. People utilizing bridge/transitional housing are considered to be homeless.	Currently homeless: Moderate/ Moderately-High score on current tool (family, youth or single)
Rapid Rehousing (RRH)	A program that assists individuals or families who are experiencing homelessness with moving as quickly as possible into permanent housing and to achieve stability in that housing through a combination of rental assistance, housing search and supportive services. People utilizing RRH programs are not considered to be homeless.	Currently homeless: Moderate/ Moderately-High score on current tool (family, youth or single)

Permanent Supportive Housing (PSH)	Combines housing with more intensive services for those with one or more chronic disabling conditions; there is no limit on length of stay as long as the tenant pays their portion of the rent and follows the rules of their lease. People residing in PSH are not considered to be homeless.	Currently homeless: High score on actuarial tool (family, youth or single)

The Allegheny Link manages Allegheny County's coordinated entry system. Link staff assess and prioritize homeless individuals and families for long term housing.[2] Annually, the Link conducts more than 2,000 assessments for homeless services.

Link staff ask a set of questions to assess current vulnerability and risk to help determine programs for which potential clients are eligible.[3] This assessment includes compiling their history of episodes of homelessness to determine if they are 1) chronically homeless (defined as having a disability and being homeless for 12 or more consecutive months, or having at least four separate homeless episodes totalling at least 12 months over the past three years); 2) fleeing domestic violence; and/or 3) a military veteran. To conduct this assessment and eligibility process, Link staff had been utilizing the Vulnerability Index-Service Prioritization Assistance Tool (VI-SPDAT).

Vulnerability Index-Service Prioritization Assistance Tool

The Vulnerability Index-Service Prioritization Assistance Tool (VI-SPDAT), developed by Orgcode (2015),[4] asks clients to provide self-reported information about their current situation and past experiences. Examples of assessment questions include "*Have you threatened to or tried to harm yourself or anyone else in the last year?*"; "*Do you ever do things that may be considered to be risky, like exchange sex for money, run drugs for someone, have unprotected sex with someone you don't know, share a needle or anything like that?*"; and "*Will drinking or drug use make it difficult for you to stay housed or afford your housing?*" This information, along with information about the length/frequency of homeless episodes, is used to establish priority for services.

VI-SPDAT scores are calculated based on a predefined matrix that weights the answer to each question. These weights are determined by the VI-SPDAT vendor and there is little information available on how they were constructed. Clients who receive a sufficiently high

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[2] *Individuals* in Allegheny County can access homeless emergency shelters directly without coordination by the Allegheny Link but all *families* experiencing homelessness must be referred to family emergency shelters by the Allegheny Link.

[3] https://www.hudexchange.info/resource/4847/hearth-defining-chronically-homeless-final-rule/

[4] OrgCode Consulting Inc. and Community Solutions. (2015). Vulnerability Index – Service Prioritization Decision Assistance Tool (VI-SPDAT): Prescreen Triage Tool for Single Adults.

score are placed on a waiting list for relevant programs. In 2019, more than 2,000 such assessments were conducted.

The VI-SPDAT relies upon self-reported information and is dependent upon a client's memory and willingness to share personal information. Asking people in the midst of a housing crisis to provide answers to sensitive personal questions is not the best way to conduct an accurate assessment. DHS identified this and a number of other concerns related to use of the VI-SPDAT for assessing and prioritizing clients for services:

- The VI-SPDAT assessment can take up to 45 minutes to administer.
- The VI-SPDAT has not been validated for Allegheny County, meaning that its effectiveness at stratifying higher-risk individuals and families is unclear.
- Some VI-SPDAT assessment questions are difficult to ask someone in a crisis because they are intrusive and potentially stigmatizing. This can lead to a situation in which the relationship between agency and client is undermined, especially if the client reveals extensive private information and is still not offered any services. Feedback from focus groups confirmed that it was often difficult for clients to answer these questions.
- Too often, individuals and families score high enough on the VI-SPDAT to be put on the waiting list but not high enough to ever receive services.
- Because recollection of past experiences (especially traumatic experiences) can be faulty, there are concerns that VI-SPDAT scores may not result in accurate waiting list status, particularly for already-stigmatized groups.
- Much of the information required by the VI-SPDAT is already held within DHS's administrative data, meaning that it is unnecessary for Link call screeners to ask for this information.

Considering these concerns, DHS questioned whether housing placement decisions were being made based on accurate information and whether the limited number of available slots were going to the individuals and families who could most benefit from them. Figure 1 illustrates the process by which homeless individuals/families were assessed and prioritized for housing prior to implementation of AHA. First, a person experiencing homelessness would make contact with the Link, either by telephone or in person via an office visit with a Link staffperson. Second, a number of questions were asked to confirm the person's housing status, determine if they might be eligible for programs that serve special populations (e.g., families with children, veterans, 18-through-24-year-old youth and people experiencing domestic violence) and complete the VI-SPDAT assessment. These inputs generated a score and the person/household was added to the housing waiting list. When a program had a vacancy, Link staff made contact with the client to confirm that they were still experiencing homelessness and to discuss the housing program to which the client was being referred. An electronic referral was then sent through the County's homeless data system to the service provider with the client's information to begin the client enrollment process.
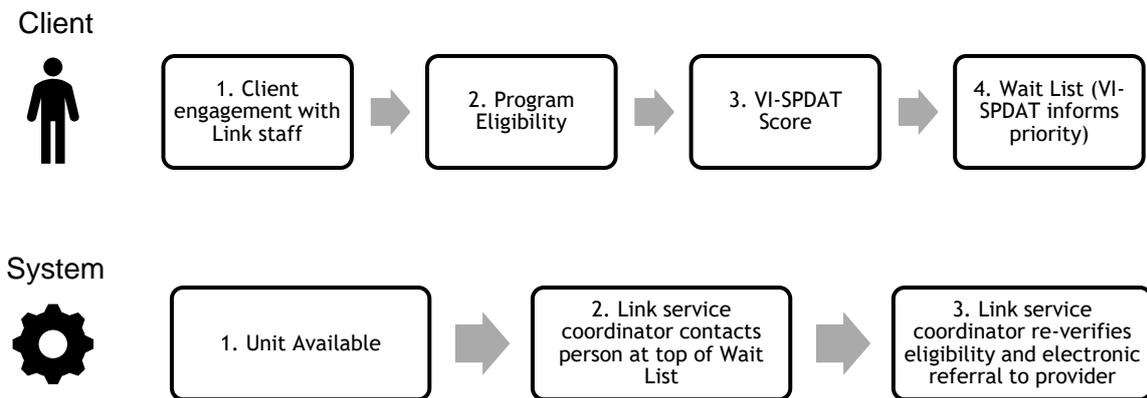
Predictive Risk Modeling (PRM)

Unlike human judgment alone or structured decision tools such as the VI-SPDAT, predictive risk modeling (PRMs) use historical correlations and patterns from routinely collected administrative data to rapidly assign a risk score.

PRM uses already-collected administrative data to model future adverse outcomes that might be prevented through a more strategic delivery of services. It is fully automated, where rather than requiring the data to be acquired through interviews, the data fields are filled by automatically extracting data that the County holds in its data warehouse. PRM has been used previously in health and hospital settings (Panattoni, Vaithianathan, Ashton, & Lewis, 2011; Billings, Blunt, Steventon, Georghiou, Lewis, & Bardsley, 2012) and. more recently, in child protection and prevention settings (see Allegheny Family Screening Tool [AFST]).

Engaging the community

DHS has carried out an extensive stakeholder engagement process throughout the development of the AHA. Stakeholder groups were invited to discuss the work, its implementation and the timeline. To date, the project team has had discussions/meetings with the groups listed in Table 3.

Table 3: Community Information and Engagement Sessions

Meeting	Description	Date
City Labs 2018	Meeting of leading homelessness researchers, homeless practitioners and others interested in using advanced data analytics approaches to	10/29/18

	improve homeless services, including presentations by DHS and other jurisdictions on the use of algorithms to improve homeless services decision making; forum provided an opportunity for DHS to receive in-depth feedback from national and international experts in the field.	
Allegheny County Continuum of Care/Homeless Advisory Board (CoC/HAB) provider meeting	Presentation to homeless service provider staff within the CoC, focused specifically on the reasons for developing AHA and early data modeling results.	12/21/18
Allegheny County CoC/HAB meeting	Presentation to Allegheny County's homeless system governance board (HAB) about DHS's work in developing AHA, focused specifically on the reasons for developing AHA and early data modeling results.	1/29/19
Allegheny County Health and Housing (H2) Working Group	Presentation to the cross-sector Health and Housing (H2) committee, which meets quarterly to discuss issues related to the intersection of housing and health.	2/28/19
National Human Services Data Consortium (NHSDC) spring conference	Presentation to small group of HUD staff and homeless technical assistance providers, focused specifically on the reasons for developing AHA and early data modeling results.	4/15/19
Advanced Analytics to Improve Homeless Services, hosted by Bloomberg Philanthropies	Meeting of leading homelessness researchers, ethicists, HUD staff, homeless practitioners and others interested in using advanced data analytics approaches to improve homeless services, including presentations by DHS and other jurisdictions on the use of algorithms to improve homeless services decision making; forum provided an opportunity for DHS to	9/16/19

	receive in-depth feedback from national and international leaders in the field.	
CoC/HAB provider meeting	Presentation to homeless services provider staff within the CoC, focused specifically on providing updates on the status of the project and soliciting feedback from homeless service providers.	12/4/19
Allegheny Link staff meeting	Provided an overview of AHA, how it is being developing it, plans on when/how to implement, and solicited any feedback the Link staff had on implementing the project.	1/15/20
Focus group with clients experiencing homelessness, singles and chronic homelessness focus – Severe Weather Emergency Shelter (SWES)/Winter shelter	Focus group session, including an overview of AHA and facilitated discussion to solicit feedback on client perspective on implementing AHA tool	1/23/20
Focus group with clients experiencing homelessness, family homelessness focus - Womanspace East shelter	Focus group session including an overview of AHA and facilitated discussion to solicit feedback on client perspective on implementing AHA tool	2/6/20
Focus group with clients experiencing homelessness, youth homelessness focus - FamilyLinks DOCS shelter	Focus group session including an overview of AHA and facilitated discussion to solicit feedback on client perspective on implementing AHA tool	2/12/20
Focus group with clients experiencing homelessness, singles and chronic homelessness focus – Wood Street Commons	Focus group session including an overview of AHA and facilitated discussion to solicit feedback on client perspective on implementing AHA tool	2/14/20

Focus group with clients experiencing homelessness, youth homelessness focus - FamilyLinks DOCS shelter	Focus group session including an overview of AHA and facilitated discussion to solicit feedback on client perspective on implementing AHA tool	2/25/20
Allegheny County CoC/HAB meeting	Presentation to Allegheny County's homeless system governance board about DHS's work in developing AHA, focused specifically on plans for implementation.	5/26/20

Additionally, the County contracted with an external party - Eticas - which undertook an independent ethical evaluation of the model. Their report is available here.

Methodology

In this section we describe the methodology used for building the AHA, including some of the explorations we conducted to arrive at the final model.

Data

The research data set comprised 5,531 homelessness assessments conducted by the Allegheny Link between January 2016 and March 2017. While assessments are conducted for household units, the research data set is unique at the adult assessment level. For example, if there were two adults in an assessment, they are represented by two rows of data in the research data set. The 5,531 of research data represent 4,350 unique clients.

Coded features

For each assessment, a set of features was built – that is, attributes about individuals that are known in the administrative data systems of Allegheny County at the assessment date. The County runs an integrated data warehouse, so data were able to be extracted about the relevant individuals from the following systems: demographic, prior intervention with homeless services, prior interventions with assisted housing services, child welfare, juvenile probation, jail, courts, behavioral health, poverty rates and household information. Table 4 summarizes the overall domains of the predictor variables. *It is important to note that behavioral and physical health data reflect services paid for by Medical Assistance (Medicaid) or by Allegheny County; commercially paid services are not included. More than 90% of individuals involved in the homelessness system either received Medical Assistance or were uninsured.*

Over 370 features were built for individuals falling within each of the domains. Where the unit was a family, these features were constructed for each adult as well as other adults and children included in their assessment. This means that individuals in a family assessment have 736 more features which relate to other adults and children in the assessment unit, giving them a total of 1,106 features. For example, the row representing the mother would include details about her partners and children as additional predictors.

Table 4: Overview of Coded Features

Domain	Description/ Examples	Count of Predictors
Child Welfare	Count of child welfare referrals with one of the roles among parent, alleged perpetrator, victim, child in the last year, 2 years, 3 years or ever, that were screened in, screened out or active.	69
Jail	Count of months spent in Allegheny County Jail in the last year, 2 years, 3 years or ever. A dummy variable to indicate current involvement.	5
Courts	Count of months with different types of court involvement (ex: Probation/Family Delinquency/Common Pleas/ Magisterial District) in the last year, 2 years, 3 years or ever. Dummy variables to indicate current involvement.	65
Juvenile Probation	Count of months spent in Juvenile Probation (placement/nonplacement) in the last year, 2 years, 3 years or ever. Dummy Variables to indicate current involvement.	10
Behavioral and Physical Health[5]	Dummy Variables to indicate health incidents in the last year, 2 years, 3 years or ever. Count of days in mental health or physical health services, including crisis, inpatient and selected outpatient services in the last year, 2 years, 3 years or ever.	126
Previous interactions with Homeless Services	Count of day/ episodes spent in Permanent Supportive Housing (PSH), Rapid Rehousing, Bridge/Transitional, Homeless Prevention Service program, Emergency	54

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[5] Behavioral and Physical Health includes only those services provided under Medical Assistance or for uninsured individuals.

	Shelter and Street Outreach in the last year, 2 years, 3 years or ever.	
Previous interactions with Assisted Housing	Count of months spent in Allegheny County Housing Authority (ACHA) or Housing Authority of the City of Pittsburgh (HACP) public housing in the last year, 2 years, 3 years or ever.	20
Demographics	Age and gender categories	14
Poverty	Dummy variables to indicate poverty rate category and the Poverty Rates taken from "2008-2012 5-year American Community Survey (ACS) ZIP code statistics".	7
Household	All the above for other adults and other children in the family	736

Characteristics of Assessed Individuals

Table 5 provides a demographic description of the research data. Note that individuals could be represented multiple times in the research data and in these summary statistics if they had multiple assessments over the study period of January 2016 through March 2017. Gender, age, VI-SPDAT type and disability data were extracted from the Allegheny Link application.

About half of client assessments by the Link were of Black individuals/families (51%); 37% were of white. Race was missing for 9% of client assessments. Half were female; half were male. Race-gender breakdown shows that 28% were Black females, 24% were Black males, 19% were white males and 18% were white females. *Note that race is provided here as a descriptive statistic only and was never used as a predictor in the model.*

Table 5: Descriptive statistics of the research data set (n=5,531)

		Count	Percentage
Race	Black	2823	51.04%
	White	2033	36.76%
	Other	187	3.38%

	Race Missing	488	8.82%
Gender	Female	2806	50.73%
	Male	2725	49.27%
	Gender Missing	0	0.00 %
Race-Gender	Black-Female	1497	27.07%
	Black-Male	1326	23.97%
	White-Female	970	17.54%
	White-Male	1063	19.22%
Household Type	Single	3423	61.89%
	Youth	373	6.74%
	Family	1735	31.37%
Disability (self-reported)	Yes	4654	84.14%
	No	877	15.86%

Note: Race and gender are as recorded in the County data warehouse. Household type is determined by the type of VI-SPDAT completed by the person; disability is as reported to the Link by the respondents.

Selecting Target Outcomes

PRMs are trained to predict a target outcome or outcomes. Since we are looking to use the PRM to prioritize homelessness services, the ideal outcomes to train the model on are either 1) experiencing the types of adverse events that PSH or RRH beds are designed to prevent or 2) future chronic homelessness (e.g., being on the street or in a shelter).

The challenge with building PRMs is that these target outcomes - be they harm from chronic homelessness or homelessness itself – have to be recorded in the administrative data in order for the model to be trained to identify people as "at risk" of the outcome. If the outcome is not directly observable in the administrative data, then we are restricted to using proxies. Unfortunately, proxies found in administrative data sets can be biased indicators of the true phenomena that we are trying to capture. For this reason, it is important to look at a broad set of indicators, check the validity of PRM scores using more objective measures of harm, and undertake detailed analysis of the PRM tool's bias by looking as how it prioritizes people with specific characteristics.

Risk of chronic homelessness in the future

While ideally we would like to identify and prioritize individuals and families at heightened risk of chronic homelessness, measuring this from administrative data is problematic. This is because we do not observe true homelessness, rather we can only observe future interactions with the homelessness system (such as being in a shelter).

However, future interactions with the homelessness system are predicated on the sorts of services that the person might have received at the initial assessment. For example, if the individual was offered PSH they are unlikely to have further contact with the homelessness system in the next 12 months. One potential measure of future homelessness is whether the person had a shelter service or street outreach contact in the following 12 months *if they did not receive any PSH or RRH*.

Overall, around 85% of people who are assessed by the Link and who do not receive a PSH or RRH bed appear to "self-resolve" in the sense that they do not re-contact the Link, nor do they appear in a shelter or a street outreach contact within 12 months.

We explored three potential definitions of future chronic homelessness. As discussed in the appendix, since there is no ground truth survey of whether people are rough sleeping or homeless, objective measures of future homelessness are not available as a target outcome. We therefore experimented with a range of suitable proxies. Table 24 in the Appendix contains more details about our attempt to build a prioritization tool using proxies of chronic homelessness.

These models proved to not be as accurate as the harm models, and external validation was also poor (we go into more detail in the Appendix). In the end, we decided against including chronic homelessness as a target for AHA.

Harm from unstable housing

Mortality is perhaps the most directly observable harm caused by unsafe housing and is observed in the administrative data, so we could theoretically train a model to predict mortality risk. However, mortality rates have low prevalence (around 1.5% of the adults in the data died within 12 months of assessment) and given the small size of the training data set, we decided against training the model for mortality. Additionally, training a model for predicting mortality has considerable ethical implications. For example, how should such information be communicated to the individual? Instead, we use mortality to provide an

"external" validation of the tool by analyzing the mortality rates of those who are identified as high risk by the PRM tool.

Other harms associated with a lack of safe accommodation include poor mental and physical health, increased substance use, victimization, domestic abuse, sexual violence and involvement with the criminal justice system. Not all these harms have proxies in the data.

For an initial model exploration exercise, we focused on the following proxy harms:

(1) At least one night of Medicaid-funded behavioral health inpatient treatment as a proxy for undertreated mental illness
(2) More than four emergency room visits as a proxy for unmanaged crises in physical health
(3) Jail booking as a proxy for involvement in the criminal justice system
(4) Substance use services[6] as a proxy for substance abuse

One of the challenges of using service interactions as a proxy for harm is that often people who use services might in fact be less at risk of objective harm than people who do not use them. For example, people who have no transport might be less likely to get to the hospital ER, therefore those using the ER may be less at risk of poor health than those who need health care but are unable to go as frequently because of transportation problems.. For this reason, we need to also look at additional objective measures of harm to validate the model. We use 12-month mortality to do so.

Table 6: Overview of Outcomes

Outcomes	Description of Target Outcome	Prevalence
Mental Health (MH) Inpatient	At least one inpatient mental health service funded by Medicaid in the 12 months following the assessment	16.02%
Jail Booking	At least one Allegheny County Jail booking in the 12 months following the assessment	16.25%
Emergency Room (ER) 4+ Visits	More than four emergency room visits in the 12 months following the assessment	20.59%
Substance Use Services	At least one substance use service contact in the 12 months following the assessment	29.22%

| Mortality (for external validation only) | Death registered in Allegheny County death records in the 12 months following the assessment | 1.50% |

Note: All outcomes are linked to the assessment data by using Allegheny County data linkage systems which generate unique client IDs for everyone who comes into contact with the system.

Domestic Violence Harm

One of the limitations of the set of proxy outcomes outlined in

Table 6 is that it does not capture victimization by violence, particularly domestic/intimate partner or sexual violence. As we explain in the section on the business rules, all clients will still be asked a list of eligibility questions in addition to administration of the AHA; one question will be asked to determine whether homelessness is due to domestic violence.

Although the absence of a suitable proxy for domestic violence might be of concern, there are policies in place that effectively prioritize housing for those experiencing homelessness due to domestic violence (e.g., all clients will continue to be asked about domestic violence, there are domestic violence-specific beds in the system, and the business rules prioritize people who self-report domestic violence). Nevertheless, this is an area that will require continuous monitoring.

Modeling Methodology

LASSO Regularized Logistic Regression

The likelihood of experiencing each proxy harm (target outcome) given in Table 6 was modeled separately using LASSO (Least Absolute Shrinkage and Selection Operator) Regularized Logistic Regression method (Tibshinari,1996).

Each of these models is a function of the set of predictors summarized in Table 2. Logistic Regression models are commonly used to relate the likelihood that an outcome occurs to a linear combination of weighted features. LASSO Regularized Logistic Regression improves upon standard Logistic Regression by producing models that often rely on only a subset of available features – thereby reducing model complexity – and improving predictive accuracy when the number of available features is large, as is the case here.

First, we partitioned our research data set into a training set containing 3,805 (69%) records and a testing set holding 1726 (31%) records. Those individuals who died within the outcome period were by definition in the testing set, because we don't have the full 12-month followup period to observe the training outcomes for these people. Furthermore, when individuals appear multiple times in the data, we partition them to be consistently either in testing or training. Additionally, if they are families, we take all members of the family and apply the partition rule to the entire family group, ensuring appear only in testing or training. For this, we use a household identifier as the blocking variable. This may allow adults who appear in more than one family unit to be represented in both testing and training sets, although this is extremely rare.

After suitable partitioning, each risk model was instantiated through the R package named 'glmnet' (Friedman et al, 2010, version 3.0[7] (Friedman et al, 2019). In the model training phase, the LASSO parameter often symbolized as Lambda was optimized within the range of 1e-04 to 100. The Lambda parameter was tuned through a 3-times 10-fold cross-validation procedure. Repeated cross-validation is one of the standard methods to estimate classification error rates (Kim, 2009).

The Area Under the Receiver Operator Characteristic Curve (AUC) from each of the repetitions are averaged. Among 100 different Lambda values that we tested, the model that corresponded to the highest AUC was considered the best Lambda and was chosen as the final model.

All four models were trained on the complete set of predictors (1106 features). Table 7 shows the count of weighted features in the final model.

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[7] https://cran.r-project.org/src/contrib/Archive/glmnet/

Table 7: Weighted Feature Count, by Model

Model	Count of weighted features
MH Inpatient PRM	77
Jail PRM	34
ER 4+ PRM	25
Substance Use PRM	77

Model Methodology Comparisons

Table 8 and Table 9 provide the performance of each individual model and across models. Table 10 provides the "external validation" which looks at the relative risk mortality rate of the highest risk (10%) vs. the 90% for each of the methods and models.

Table 8 looks at the various measures of predictive accuracies calculated for a hold-out sample of test data (i.e., the data set of 1,726 assessments that were not used to train the model). Column 2 looks at the predictive accuracy as indicated by the AUC, which provides a generalized measure of predictive accuracy. If the AUC is 50% it means that the model provides no advantage in predicting that particular outcome, whereas an AUC of 100% means that a person who has the particular outcome (e.g., MH inpatient stay in the next year) will *always* get a higher risk score than someone who doesn't have that outcome. The Substance Service Use model has the highest AUC with 86% [84%, 88%] and the Jail model has the lowest at 80% [78%, 83%]. These results show that these individual models are accurate in ranking people at risk of these harms. Given a randomly selected case known to have the event (A), and a random selected case known to *not* have the event (B), the AUC is the likelihood that risk(A) > risk(B). For the purposes of ranking and prioritizing people into housing, the AUC therefore provides evidence of "ranking" ability.

Table 8, column 2, shows the positive predictive value (PPV). This is the share of people who receive a score of 10/10 (i.e., in the top 10% of the 1,726 people who are risk scored in hold-out data) who end up with the outcome that the model is predicting. Of the top 10% of people in the MH inpatient model, 61.2% end up with an inpatient stay within 12 months of being assessed for homelessness services, the ER 4+ have a PPV of 71%, Jail bookings have a PPV of 51% and Substance Use services have a PPV of 84%. The PPV rate also depends on the baseline prevalence of the target outcome. For example, only 16% of the population has an MH inpatient or Jail event – this means that the PPV rate will tend to be

lower. To understand this, suppose the prevalence of the target outcome is 5%. Then even if we are 100% correct in predicting the event, the PPV of the top 10% would be 50%.

Table 9 displays the model's predictive power with respect to the outcomes that the model is trained on as well as the other outcomes. We calculated the AUC for the model's own outcomes using a hold-out data set that was not used to train the model. Consider the MH Inpatient PRM model, in which the AUC is 84% for predicting MH inpatient stays. Additionally, the model is also reasonably predictive of ER4+ visits (AUC of 74%) and Substance Use (AUC of 77%) but is weaker at predicting a booking in Jail (AUC of 67%). Looking across the various models and their ability to predict the trained outcomes and untrained outcomes suggests that there is not one model that dominates in its ability to predict across the broad range of harms that we are interested in.

Table 10 provides external validation with respect to mortality. The numbers show the relative risk of mortality of those individuals scoring in the top 10% (scoring 10/10) relative to the rest of the individuals in the data set. The MH Inpatient, ER 4+ and Jail models show that high scored individuals are at considerably higher risk of mortality than those who scored in the range of 1-9, ranging from 2.55 times (95% c.i 1.52 to 4.28) for those at risk of ER 4+ visits to 1.82 (95% c.i 1.05 to 3.15) of those who score high on the Jail model. The exception is Substance Use services, where the estimated relative risk is not significantly different from 1. This is surprising given the opioid crisis and high number of related deaths. One reason for this could be that the training outcome (interaction with Substance Use services) is not a good proxy for the actual harm of interest (substance use). The challenge with having Substance Use services as a training outcome is that (unlike the other outcomes) it is not an undesirable outcome. For instance, an unplanned mental health inpatient admission or more than four ER visits suggest poor primary care. Engagement with substance use services is more mixed, in that the fact that the person is a substance user is an adverse outcome, but that they are engaging in services is positive. For this reason, and the lack of strong correlation with mortality, we dropped substance use as a training outcome and used the MH Inpatient, ER4+ Visit and Jail booking models.

Table 8: AUC, Positive Predictive Value (PPV) and True Positive Rates (TPR) of Each Model, Testing Set

Model	AUC (95% confidence interval)	PPV for top 10% risk group	TPR for top 10% risk group	Prevalence (test set)
MH Inpatient PRM	84% [82%, 87%]	62%	41%	15.82%
ER 4+ PRM	83% [80%, 85%]	71%	34%	21.61%
Jail PRM	80% [78%, 83%]	51%	31%	16.05%
Substance Use PRM	86% [84%, 88%]	84%	30%	28.74%

Notes: n= 1,726. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the Link assessment. ER 4+ Visits: More than Four ER visits in the 12 months4 following the Link assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the Link assessment. Substance Use services: At least one substance use service contact in the 12 months following the Link assessment.

Table 9: AUC of Each Individual Model and Across Models, Testing Set

Model	Outcomes			
	MH Inpatient	ER 4+ Visits	Jail booking	Substance Use Services
MH Inpatient PRM	82%	74%	67%	77%
ER 4+ PRM	78%	83%	63%	73%
Jail PRM	70%	63%	80%	73%
Substance Use PRM	79%	71%	71%	86%

Notes: n= 1,726. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the Link assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the Link assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the Link assessment. Substance Use services At least one substance use service contact in the 12 months following the Link assessment.

Table 10: Relative Risk of Mortality by Model (excluding those who received PSH and RRH/Bridge/Transitional Housing)

Model	Relative Risk of Mortality (12 months following assessment)
MH Inpatient PRM	2.20 [1.31, 3.70]
ER 4+ PRM	2.55 [1.52, 4.28]
Jail PRM	1.82 [1.05, 3.15]
Substance Use PRM	1.53 [0.85, 2.78]

Notes: n= 4,324. Relative risk calculated using Stata version 16.0 "glm" command. Estimated confidence intervals use robust standard errors. Mortality is measured as death registered in Allegheny County death records in the 12 months following the Link assessment.

Model Performance – Future PSH and RRH/Bridge/Transitional Housing excluded

When building PRMs, one ideally wants access to "experimental" data where no interventions are offered that might have some impact on these outcomes. However, in our sample we have people who received PSH or RRH/Bridge/Transitional Housing and these services might have been protective of exactly the outcomes that the models are trained to predict. In this section we establish whether the models are equally accurate for people who *did not* receive these services. Table 11 provides the AUC, PPV and TPR for each outcome. All statistics are similar, suggesting that predictive accuracy is not being undermined by the fact that we do not have an experimental sample.

Table 11: AUC, PPV and TPR by Model (excluding people who received PSH and RRH/Bridge/Transitional Housing, Testing Set

Model	AUC (95% confidence interval)	PPV for top 10% risk group	TPR for top 10% risk group
MH PRM	83.96% [81.06%, 86.85%]	59.38%	37.07%
ER 4+ PRM	83.90% [81.4%, 86.4%]	71.76%	35.21%
Jail PRM	80.56% [77.43%, 83.68%]	52.82%	34.72%

Substance Use PRM	86.02% [83.68%, 88.35%]	81.3%	28.25%

Notes: n= 1,341

The AHA Tool

Figure 2: Mapping of individual PRM model scores to AHA scores
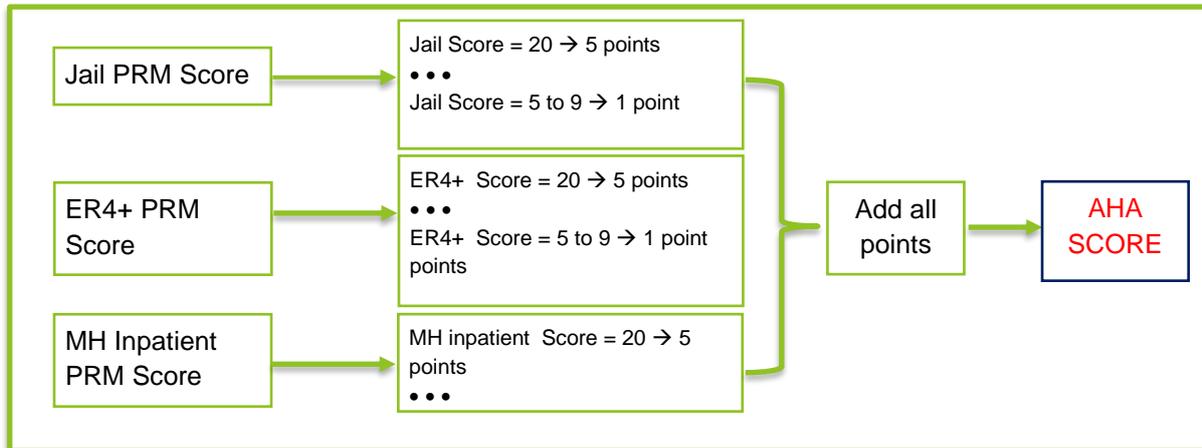
To be useful, the final tool would provide a single score that would allow the agency to prioritize people for services. One approach would be to have a single model that targets people who have at least one of the events. However, this means that people who were at higher risk of events with higher prevalence (i.e., ER 21%) would be prioritized.

We therefore decided to deploy a "combined" model, which works by scoring each person according to the score for each of the three models (MH Inpatient, Jail, ER 4+ visits) (see

Figure 2). As discussed previously, we excluded the Substance Use PRM because the estimated relative risk is not significantly different from 1 and the possibility that interaction with Substance Use services might be protective, rather than a risk or adverse outcome, because the person is seeking treatment.

The weights were translated as follows: Individuals received 5 points for each model in which they scored 20, 4 points for each model in which they scored 18-19, 3 points if they scored 15-17, 2 points if they scored 10-14 by 2, and 1 point if they received a score of 5-9. . Then the sum of those weights was recalibrated for 10 equal size buckets, each of which was defined by a decile.

Table 12 provides information on the AHA model AUC in predicting each of the three outcomes. The AHA performed well across all three outcomes of interest with an AUC between 83% for MH inpatient and 71% for Jail bookings.

Table 13 presents the TPR, PPV and Relative Risk of the AHA with respect to scoring 10. This is provided for comparison with the individual models, but as is clear in what follows, the

business rules imply that more than those who score a 10 will be served with PSH or RRH/Bridge/Transitional Housing.

Table 12: AUC for AHA, by Model

Outcomes	AUC of AHA
MH inpatient	82.70%
Jail booking	71.23%
ER 4+	79.19%

Notes: n= 1,726. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the Link assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the Link assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the Link assessment.

Table 13: TPR, PPV and RR of AHA, by Model

Outcomes	PPV for top 10% risk group	TPR for top 10% risk group
MH Inpatient	63.48%	26.74%
Jail booking	41.74%	17.33%
ER 4+	66.96%	20.64%

Notes: n= 1,726. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the Link assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the Link assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the Link assessment. Relative risk calculated using Stata version 16.0 "glm" command. Estimated confidence intervals use robust standard errors. Mortality is measured as death registered in Allegheny County death records in the 12 months following the Link assessment.

Comparing the predictive accuracy of the AHA with the VI-SPDAT

An important question for Allegheny County was to understand how the AHA compared with the VI-SPDAT in its ability to identify people who are at risk of the proxy harms. Figures 3 to 5 show the rate of the harm according to the score received in the AHA and the prevalence of the outcome.

The VI-SPDAT score ranges from 1 to 14 and people do not fall equally into each of these categories. By construction, the AHA forces about 10% of clients to receive each score. To compare the VI-SPDAT with the AHA, we ranked people according to the VI-SPDAT scores and grouped them in deciles (with arbitrary tie-breaking where necessary). This means that a VI-SPDAT score of 10 indicated that the client received the highest 10% score category in the VI-SPDAT.

Table 14: AUC of AHA vs VI-SPDAT

Outcomes	AUC of AHA – testing set only	AUC of VI-SPDAT
Mental health inpatient service	82.70%	58.85%
Jail booking	71.23%	56.69%
ER 4+	79.19%	56.78%

Notes: n= 1,726. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment.

Figure 3, 4 and 5 plot the prevalence of proxy harms of Jail, Mental Health inpatient stays and ER 4 plus visits. We have plotted the assessments that were related to single and youth ("singles") separately to those related to family units. For all proxy harms, we see that the AHA is considerably more predictive than the VI-SPDAT.

Figure 3: Proportion of Individuals with a Jail Booking within 12 Months of Assessment, Testing Data
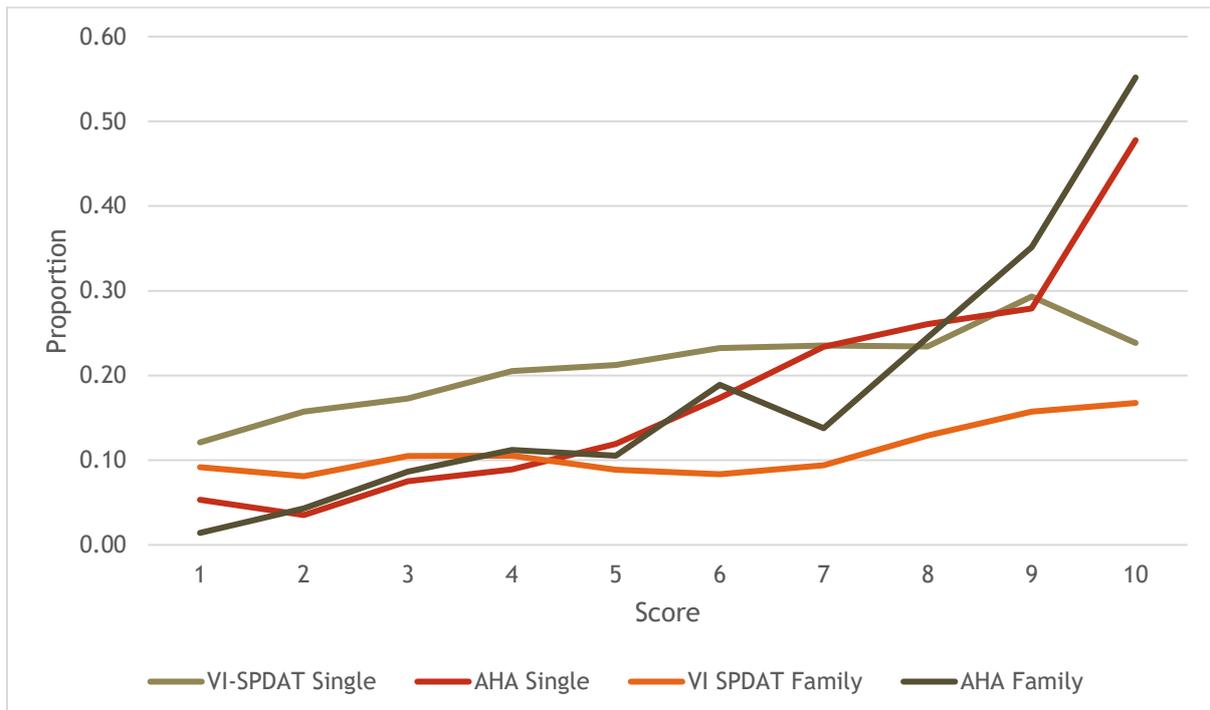
Notes: Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment. Raw VI-SPDAT scores have been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

Figure 4: Proportion of Individuals with at Least 1 Night Inpatient Stay with a Behavioral Health Code within 12 Months of Assessment, Testing Data
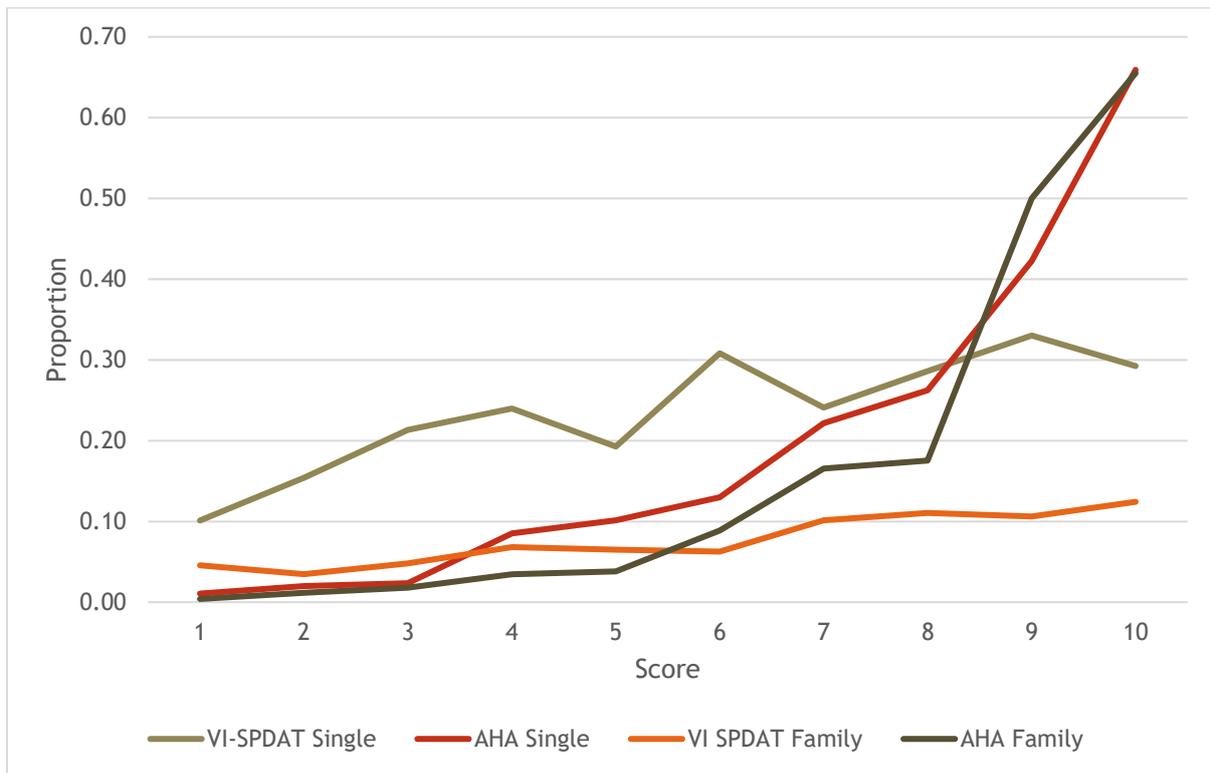
Notes: MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. Raw VI-SPDAT scores have been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

Figure 5: Proportion of Individuals with More than 4 Emergency Room Visits within 12 Months of Assessment, Testing Data

Notes: ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Raw VI-SPDAT scores have been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

Figure 3, 4 and 5 may be indicative of a VI-SPDAT that is less accurate at predicting the proxy harms, the absence of strong association (and even the negative association) observed could be a result of these clients receiving services because of their high VI-SPDAT score. If these services (such as PSH or RRH) are protective of these proxy harms, then we might expect the VI-SPDAT to be less strongly associated with these outcomes because high VI-SPDAT clients received the protective effects of housing.

Figure 6, 7 and 8 present the same graphs, Jail, MH and ER4+ Outcomes, respectively, for singles based on VI-SPDAT scores (and excluding those who received PSH and TR services in the 12 months following the assessment) and confirms that the lack of correlation between the VI-SPDAT score and outcomes is not because of the protective effects of housing offered to high scoring VI-SPDAT.

Figure 6: Jail Bookings (excluding PSH, RRH and Bridge/Transitional Housing)

Notes: Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment. Raw VI-SPDAT scores h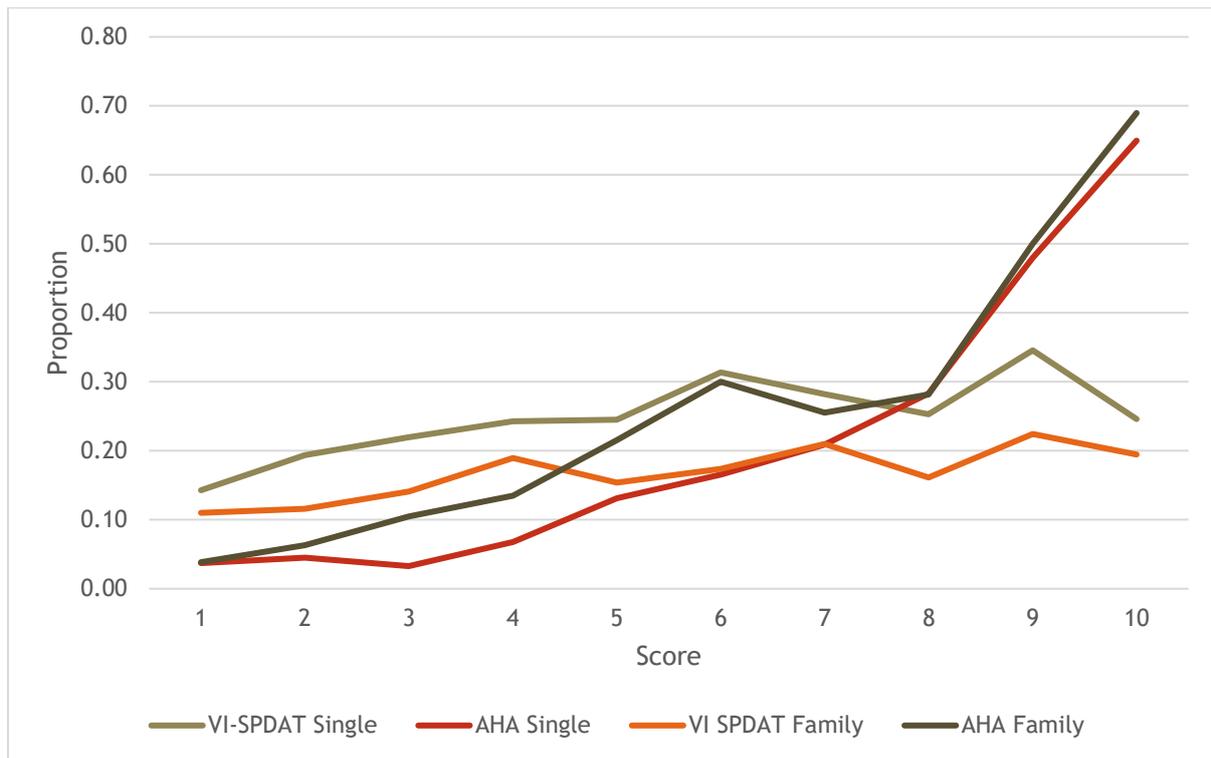ave been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

Figure 7: MH Inpatient (excluding PSH, RRH and Bridge/Transitional Housing)
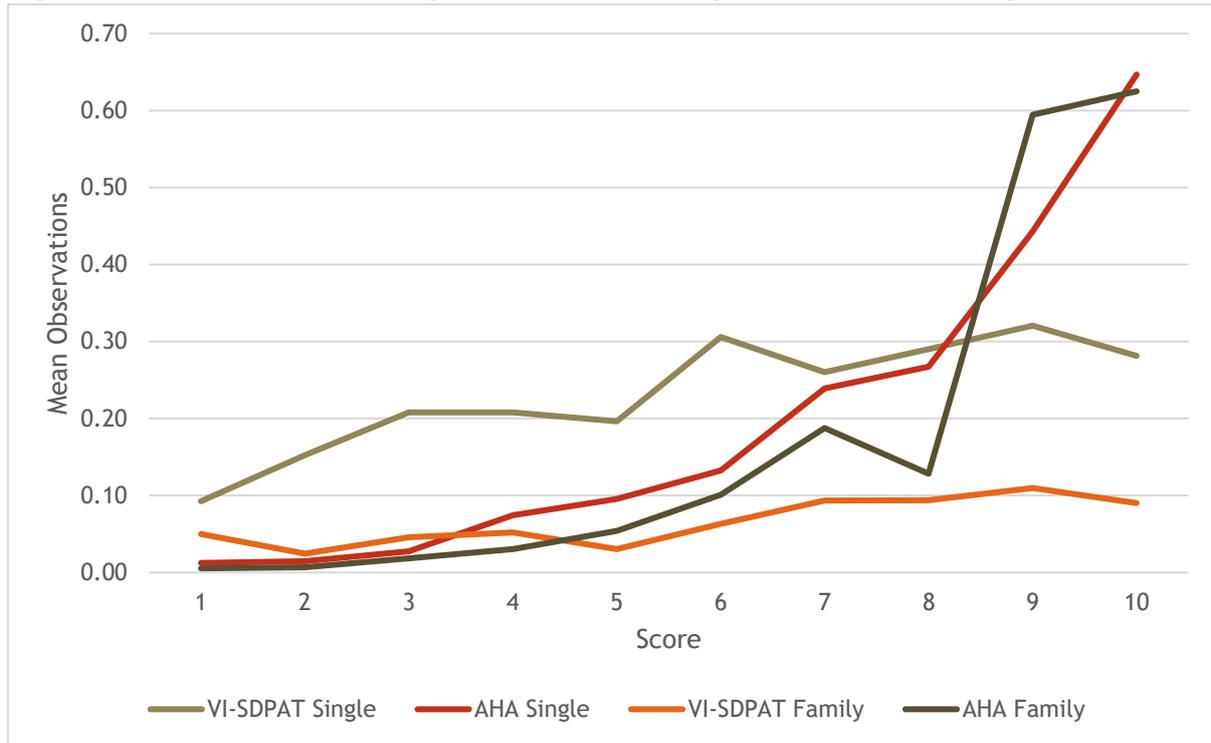
Notes: MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. Raw VI-SPDAT scores have been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

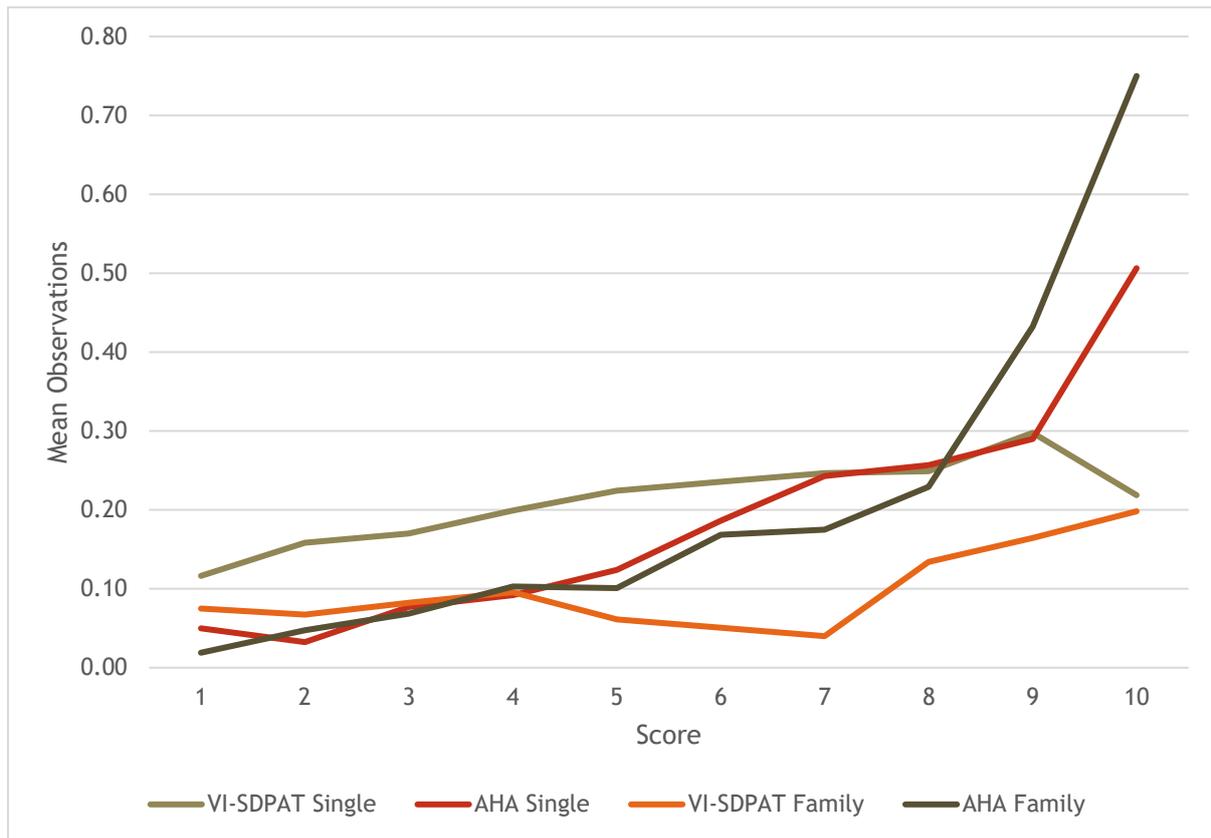*Figure 8: ER4+ (excluding PSH, RRH and Bridge/Transitional Housing)*
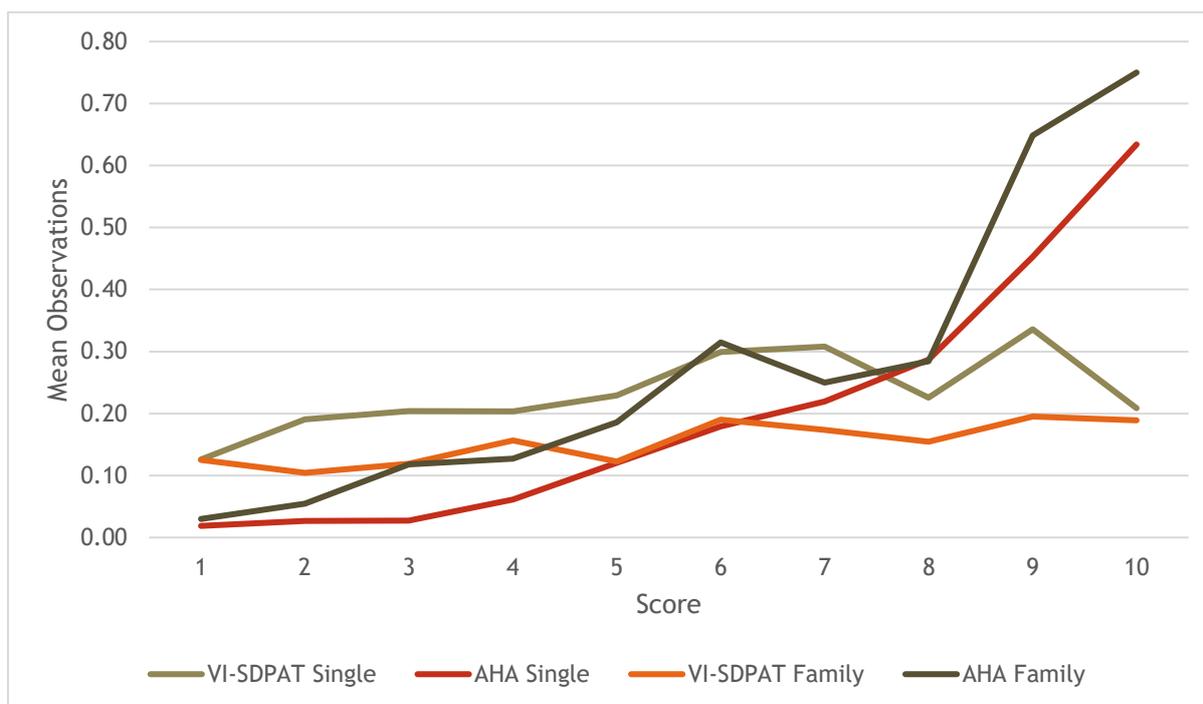
Notes: ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Raw VI-SPDAT scores have been converted into scores with 10% of assesments in each group as follows: Score 1 means a VI-SPDAT raw score of 0-4; score 9 is raw VI-SPDAT score of 10 or 11; and score 10 is a raw VI-SPDAT score of 12 plus.

As an additional test for the impact of non-experimental training data on the modeling, we also rebuilt a model that excluded those who had received housing (PSH and RRH/Bridge/Transitional Housing). We then applied this model to those who had received PSH and RRH/Bridge/Transitional Housing. That is, we treated those who had received the programs as a second hold-out testing set. We compared the scores generated by this alternative model to that of AHA for those who received housing services. The scores were not statistically significantly different (using conventional t-test) between these two models. This suggests that our decision to use the whole sample as a training set, and not to exclude those receiving PSH and RRH/Bridge/Transitional Housing, was not causing any obvious bias in the PRM tool.

Business Processes and the AHA

The AHA will be used – together with eligibility rules and a set of business rules – to determine who gets prioritized onto the waiting list and then off the waiting list for beds. These rules were designed with the following principles in mind:

- Need is measured by AHA score and history of chronic homelessness.

- Highest need people on waiting lists should be the first to be offered an available bed.

- People should not be placed on waiting lists if they have no chance of getting a bed or unit.

- Specific types of beds (e.g., DV or Vet only beds) must be filled by people who meet eligibility criteria.

- Families are housed in family units.

Business Rules: Housing Units Prioritization Rules

Constructing the business rules was an exercise in matching what was expected to be the supply of beds in the 2019-20 year and the demand for the 12 months following the release of the AHA (2020-21). To do this we needed the most recent data on demand. We therefore extracted assessments completed from November 2018 through December 2019 and applied the AHA to this population. In this data set there were 2,244 singles (singles and adults in the families without children) assessments and 687 family (families with children) assessments.

Note that this was done before the onset of the COVID-19 pandemic. The economic downturn that is expected at the time of writing this report suggests that high levels of unemployment are forecasted, leading to unusually high demand for homeless services.

In Table 15, we present the number of beds expected in the 2019-20 period. Note that this is not the full number of beds occupied but rather the count of beds expected to become free over the course of 12 months and those needing to be filled. Overall, we expect to fill about 101 single PSH beds - of which eight must be assigned to a veteran and two to youth (age 24 or under). There are 314 Single beds for RRH, of which 39 must be assigned to clients who are at risk of domestic violence and 61 to youth. Of the 48 PSH family beds, one will have to be assigned to a veteran. Of the 144 TH units for families, 71 are required to be assigned to clients at risk of domestic violence and five to youth. Note that eligibility rules do not imply that veterans, victims of DV or youth are not eligible for general beds. The ability to allocate general beds to special populations depends on business rules that the County adopts.

Table 15: Types and Quantity of Beds Expected to be Available to be Filled in the 2019-20 period.

Unit Type	Total Count	DV only	Vet only	Youth only
Single -PSH	101	NA	8	2
Single – RRH/BH/TH	314	39	NA	61
Family - PSH	48	NA	1	NA
Family- RRH/BH/TH	144	71	NA	5

Notes: Rapid Rehousing (RRH), Bridge (BH) and Transitional Housing (TH) are combined because they are similar programs in that HUD does not require the person to have a disability and the length of service is shorter (~18-24 months).

Prioritization Schema

Individuals and families who call the Link will have an AHA score generated. They will be put on a waiting list if they meet the eligibility requirement and their score is high enough. They enter the waiting list for one of four categories and, when a bed becomes available, the client waiting the longest for that type of bed *within their priority group* is contacted. If they meet the eligibility criteria (determined by reassessment by the AHA), they receive the bed.

For example, if a single PSH (Veterans only) bed becomes available, the County will look at its waiting list and see if there is anyone in priority group 1 who is a veteran. If there is not, they will look at priority group 2, and so on. We have constructed the schema so that the total number of people on the waiting list at any time should be constant and should not fluctuate (see Figure 9 – Figure 12). However, the County will have to monitor this; if they find that the waiting list is growing (or shrinking) over time, they may have to drop priority group 4 (or add an extra priority group).

Figure 9: Single PSH Priority Scheme

Priority 1: Score 10 and (DV or Youth or Vet) when Chronic

↓

Priority 2: Score 10 and non (DV or Youth or Vet) when Chronic

↓

Priority 3: Score 9 and (DV or Youth or Vet) when Chronic

↓

Priority 4: Score 9 and non (DV or Youth or Vet) when Chronic
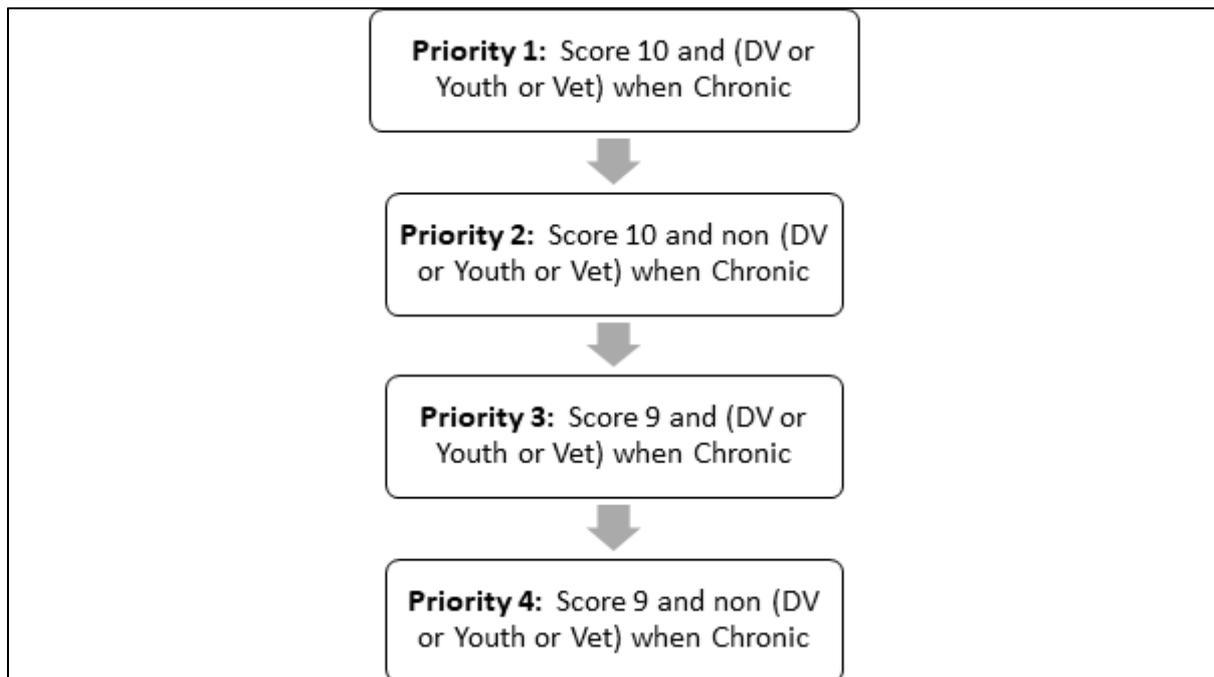
Figure 10: Single Rapid Rehousing, Bridge Housing and Transitional Housing Priority Scheme

Priority 1: Score 9 or above when Chronic

↓

Priority 2: Score 8 when Chronic

↓

Priority 3: Score 9 or above and (DV or Youth or Vet) when Non-chronic

↓

Priority 4: Score 8 and youth when Non-chronic

↓

Priority 5: Score 10 and non (DV or Youth or Vet) when Non-chronic

↓

Priority 6: Score 8 or above (DV or Youth or Vet) when Non-chronic

↓

Priority 7: Score 7 when Chronic

↓

Priority 8: Score 9 or above and non (DV or Youth or Vet) when Non-chronic
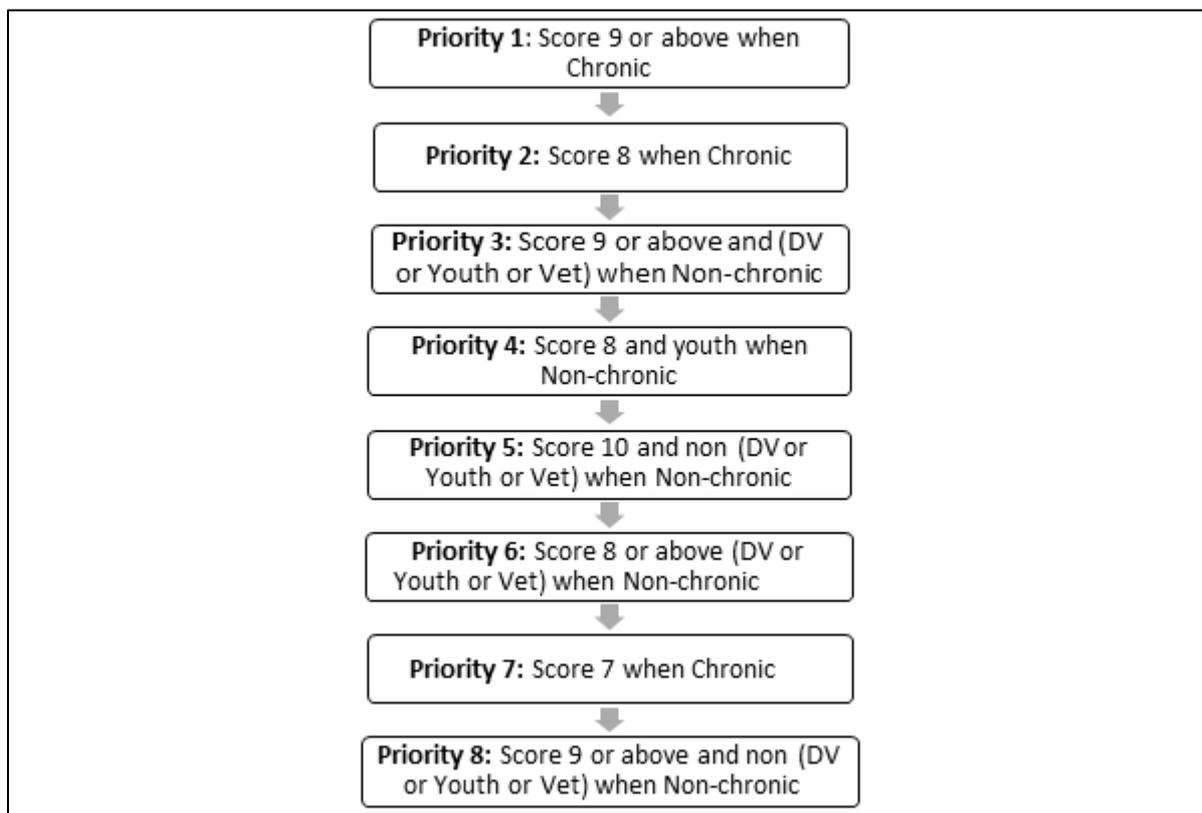
Figure 11: Family PSH Priority Scheme

Priority 1: Score 9 or above when Chronic

Priority 2: Score 10 when Non-Chronic

Priority 3: Score 9 and (DV or All-Youth or Vet) when Non-Chronic

Priority 4: Score 9 and not (DV or All-Youth or Vet) when Non-Chronic
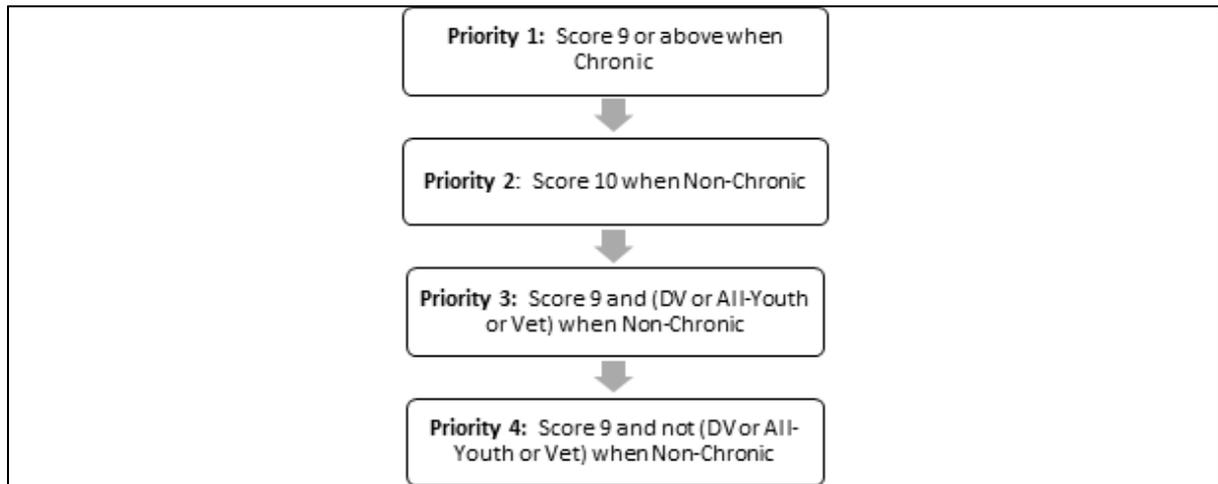
Figure 12: Family Rapid Rehousing, Bridge Housing and Transitional Housing Priority Scheme

Priority 1: Score 9 and not (DV or All-Youth or Vet) when Non-Chronic

Priority 2: Score 6 or above when Chronic

Priority 3: Score 8 and (DV or All-Youth or Vet) when Non-Chronic

Priority 4: Score 6 or 7 and DV when Non-Chronic

Priority 5: Score 8 and not (DV or All-Youth or Vet) when Non-Chronic
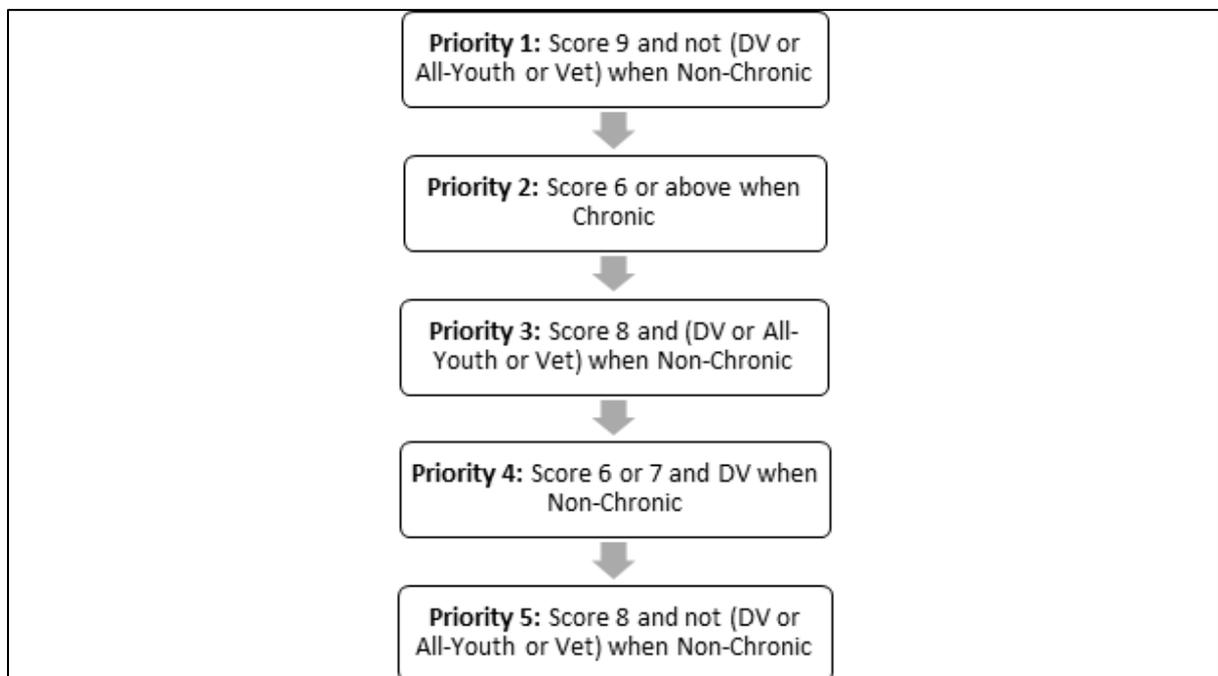
Equity and fairness analysis

Eticas has conducted an extensive analysis of the underlying modeling strategy. Therefore, instead of including a standard fairness or equity analysis of the AHA, we present Eticas' conclusions in Table 16.

Table 16: Preliminary Hypotheses and Results from the Algorithmic Impact Assessment by Eticas

Hypotheses	Risk definition	Results from the algorithmic assessment (RISK LEVEL)
Model: The combined model might not effectively measure the risk of homelessness in the next 12 months.	Some sub-groups with a high risk of becoming homeless might tend to not use inpatient mental health and ER4 systems, nor go to jail. Used data/predictors might not be accurately representing the degree and duration of the impairment.	LOW: only indirect evidence of limited risk identification was found in the cases of race, gender and veterans. Discrepancies across these groups' rates were low.
Model: People suffering chronic homelessness - meaning people with a disability (mental or physical) - might be over-protected by the system	People suffering chronic homelessness might be over-protected by the system.	LOW: the algorithm tends to provide high risk of homelessness to people with a disability (requirement for chronic homelessness) and also to other outcomes.
Race: Misrepresentation of Black/African American individuals/families	Due to the correlation of the information on the race attribute with other factors, such as the amount of information about health for different race groups.	LOW: no large discrepancies between races pointing towards discrimination, were found.
Gender: Lack of female data	The risk assessment is less accurate for the minority group (women) due to a lack of information about them.	MEDIUM: overall, women seem to be slightly under-protected by the algorithm.

Age: Age might become a risk factor in terms of vulnerability.	The age attribute may become a basis for false positives and negatives, for instance in the case of elderly people.	LOW: No large discrepancies between age groups are found. Rates are in line with age groups under more risk of homelessness.

Note: Source: "Algorithmic Impact Assessment of the Predictive System for Risk of Homelessness Developed for Allegheny County" by Eticas Research and Consulting (March 2020)

However, fairness is not just about the models themselves as analyzed by Eticas, but how the AHA is combined with business rules. Moreover, the question that agencies and communities most need to have answered is *how does the AHA allocate beds compared with the VI-SPDAT?*

Answering this question requires us to generate a counterfactual where the VI-SPDAT is used to allocate the same beds that are expected to become available over the 2019-2020 period, as shown in Table 15. To develop this counterfactual, we used the VI-SPDAT score similar to the AHA score and combined it with the same business rules as outlined in the schema shown in Figure 9 – Figure 12.

For example, under the VI-SPDAT counterfactual scenario, priority group 1 for PSH single beds are people who score in the top decile of VI-SPDAT scores, who meet the criteria for DV, Youth or Veteran, and who have experienced chronic homelessness.

We then label people "AHA+" if they would have been assigned a bed under the AHA but not under the VI-SPDAT, and VI-SPDAT+" if they would have been assigned a bed under the VI-SPDAT but not under the AHA. Those people who would have been assigned a bed in both situations are labeled "neutral."

Table 17 shows the AHA+ and VI-SPDAT+ from allocating the 415 single and youth beds using the AHA and the business rules outlined above. Overall, there were 176 single people who would have received a bed under both scenarios, while 239 clients would have been different under the AHA vs the VI-SPAT. Column 3 shows the AHA+ under the AHA, column 4 shows the VI-SPDAT+, and column 5 shows the difference between the two.

The greater number of VI-SPDAT+ under the AHA are people who are chronically homeless, where there are 93 AHA+ and 149 VI-SPDAT+, and therefore we have 56 fewer people who are chronically homeless receiving beds under the AHA than under the VI-SPDAT alternative (see column 5). There are also five fewer people with disabilities, four fewer with DV two fewer Veterans, and 14 fewer youth and females. The AHA+ are males (15 more) and Black (76 more).

We also look at the average PRM scores of the AHA+ vs. VI-SPDAT+. Overall, the average risk score of those who are AHA+ from the AHA have an AHA score of 9.19 compared to 4.57 of those who are VI-SPDAT+. As expected, the average score of the VI-SPDAT+ across the board is lower than the average score of the AHA+.

Table 18 shows the same information for families, where a similar pattern is observed, except for DV beds where there is an increase in the number served using the AHA compared to the VI-SPDAT, and for Black families where there are 14 fewer Black families receiving beds.

As expected, the average AHA scores of the VI-SPDAT+ are considerably lower than the average AHA scores of the AHA+.

Table 17: Singles, AHA+ and VI-SPDAT+ for Beds (AHA vs. VI-SPDAT)

Sub-group	Neutral	AHA+ from AHA	VI-SPDAT+ from AHA	AHA+ minus VI-SPDAT+	Average PRM Score of VI-SPDAT+	Average PRM Score of AHA+
Chronic homelessness	149	93	149	-56	4.23	8.92
Disabled	176	233	238	-5	4.58	9.26
Domestic Violence	22	26	30	-4	4.83	9.54
Veteran	15	30	32	-2	5.62	9.1
All-Youth	22	41	55	-14	3.87	8.61
Female	53	70	84	-14	4.69	9.3
Male	120	166	151	15	4.56	9.22
Black	61	142	66	76	5.33	9.19
Total	176	239	239	0	4.57	9.19

Note: Chronic Homelessness, Disabled, Domestic Violence, Veterans is as reported to the Link staff in response to specific questions. Race and Gender are as recorded in the County data warehouse and come from multiple sources. Youth are households where everyone in the household is 24 or younger. Type is determined by the types of VI-SPDAT completed by the person,

Table 18: Families, AHA+ and VI-SPDAT+ for Beds (AHA vs. VI-SPDAT)

Sub-group	Neutral	AHA+ from AHA	VI-SPDAT+ from AHA	AHA+ minus VI-SPDAT+	Average PRM Score of VI-SPDAT+	Average PRM Score of AHA+
Chronic homelessness flag	29	5	15	-10	2.73	7.4
Disabled	83	92	95	-3	3.34	8
Domestic Violence	35	52	47	5	2.87	7.52
Veteran	2	1	2	-1	1.5	8
All-Youth	11	9	11	-2	3.55	7.78
Female	71	92	94	-2	3.3	7.88
Male	13	13	12	1	3.75	8.15
Black	33	52	66	-14	3.39	7.83
Total	86	106	106	0	3.26	7.87

Note: Chronic Homelessness, Disabled, Domestic Violence, Veterans is as reported to the Link staff in response to specific questions. Race and Gender are as recorded in the County data warehouse and come from multiple sources. Youth are households where everyone in the household is 24 or younger (where age is from the data warehouse).

Summarizing the main results from this AHA+ and VI-SPDAT+ analysis, we find:

- The VI-SPDAT+ group under this policy has an AHA score of between 3.26 and 4.57, suggesting that they have a low risk of any of the harms that the AHA is designed to predict.

- The largest group of VI-SPDAT+ are chronically homeless single individuals, with a bed allocation fall of 56 among singles and 10 among families.

- The largest AHA+ group are Black singles who gain an additional 76 beds allocated under the AHA compared with the VI-SPDAT.

While further research is required to ascertain exactly why there is difference in the prioritization that occurs between the VI-SPDAT and the AHA, preliminary analysis suggests that there might be systematic differences in people's willingness to self-disclose their past. For example, we find a large difference between responses from people who answer the VI-SPDAT question about whether they have ever been in jail and the results from the administrative data. Many people who have been in jail according to the administrative data answer the VI-SPDAT questions saying they have not been in jail. There is also some early evidence that this difference is not random, and we intend to explore whether this might have contributed to the VI-SPDAT score's lack of predictive power.

AHA Alternative Assessment

In fewer than 10% of cases, we expect that households experiencing homelessness who contact the Link will have insufficient records in the County data warehouse because they are from outside the County or otherwise do not have administrative data records in the warehouse. In these cases, DHS will use an alternative assessment to generate the score.

To develop the alternative assessment, the model used the assessments that were used to train the AHA, but rather than using the administrative data systems, we used the answers to the existing VI-SPDAT questions that had been conducted with the head of households (HOH). Because we only have VI-SPDAT data for the HOH, rather than using all the 5,531 assessments that were used to train the AHA tool, we were restricted to 5,059 HOH assessments.

We generated over 350 features from the VI-SPDAT questions and 14 features from purely demographic data collected at the time of the interview or previously stored in the data warehouse (note that race is not included). One VI-SPDAT question could generate multiple features. For example, if the answer is "Yes", "No" or "Refused," the question would generate two features (with one excluded). We then excluded 39 VI-SPDAT questions that Link staff had always been uncomfortable asking or that were found to be excessively repetitive (see page Table 19).

Table 19: VI-SPDAT Questions Excluded Prior to Training the AHA Alternative Assessment

VI-SPDAT Number	Question Text
Q1	What is your current housing crisis?
Q1880	If facing eviction, how many months behind in rent?
Q1881	Is this individual 60 years of age or older?
Q1884	Where do you sleep most frequently? Where do you and your family sleep most frequently?
Q1886	In the last three years, how many times have you been homeless? Or in the last three years, how many times have you and your family been homeless?

Q1900	Have you or anyone in your family been attacked or beaten up since they've become homeless?
Q1901	Have you or anyone in your family threatened to or tried to harm themself or anyone else in the last year?
Q1902	Does anyone have a criminal history?
Q1906	Does anybody force or trick you to do things that you do not want to do? Does anybody force or trick anyone in your family to do things that you do not want to do?
Q1914	Are you currently able to take care of basic needs like bathing, changing clothes, using a restroom, getting food and clean water and other things like that? Is everyone in your family currently able to take care of basic needs like bathing, changing clothes, using a restroom, getting food and clean water and other things like that?
Q1915	Is your current homelessness in any way caused by a relationship that broke down, an unhealthy or abusive relationship, or because family or friends caused you to become evicted? Is your family's current homelessness in any way caused by a relationship that broke down, an unhealthy or abusive relationship, or because family or friends caused you to become evicted?
Q1918	Does the HoH have a chronic health condition?
Q1921	If there was a space available in a program that specifically assists people that live with HIV or AIDS, would that be of interest to you?
Q1922	Do you have any physical disabilities that would limit the type of housing you could access, or would make it hard to live independently because you'd need help?
Q1928	Do you use drugs or alcohol? Do you or anyone in your household use drugs or alcohol?
Q1929	When was the last time you used drugs or alcohol? When was the last time they used drugs or alcohol?
Q1930	Are you willing to not use drugs and alcohol to be eligible for a housing program?
Q1932	Will drinking or drug use make it difficult for you to stay housed or afford your housing? Will drinking or drug use make it difficult for your family to stay housed or afford your housing?
Q1938	Do you have any mental health or brain issues that would make it hard for you to live independently because you'd need help?
Q1939	Are there any medications that a doctor said you should be taking that, for whatever reason, you are not taking?
Q1940	Are there any medications like painkillers that you don't take the way the doctor prescribed or where you sell the medication?

Q2001	Does any single member of your household have a medical condition, mental health concern, and experience problematic substance use?
Q2007	Do you have any family legal issues that are being resolved in court or need to be resolved in court that would impact your housing or who may live within your housing?
Q2008	In the last 180 days have any children lived with family or friends because of your homelessness or housing situation?
Q2009	Has any child in the family experienced abuse or trauma in the last 180 days?
Q2011	Have the members of your family changed in the last 180 days, due to things like divorce, your kids coming back to live with you, someone leaving for military service or incarceration, a relative moving in, or anything like that?
Q2012	Do you anticipate any other adults or children coming to live with you within the first 180 days of being housed?
Q2013	Do you have two or more planned activities each week as a family such as outings to the park, going to the library, visiting other family, watching a family movie, or anything like that?
Q2015	After school, or on weekends or days when there isn't school, is the total time children spend each day where there is no interaction with you or another responsible adult 3 or more hours per day for children aged 13 or older?
Q2016	After school, or on weekends or days when there isn't school, is the total time children spend each day where there is no interaction with you or another responsible adult 2 or more hours per day for children aged 12 or younger?
Q2017	IF THERE ARE CHILDREN BOTH 12 AND UNDER 13 AND OVER: Do your older kids spend 2 or more hours on a typical day helping their younger sibling(s) with things like getting ready for school, helping with homework, making them dinner, bathing them, or anything like that?
Q2055	How many parents are in this household?
Q2084	Is this individual 17 years of age or less?
Q2083	If a housing provider asked you to take a drug test-would you pass?
Q2091	Is your current lack of stable housing: Because you ran away from your family home, a group home or a foster home?
Q2093	Is your current lack of stable housing: Because your family or friends caused you to become homeless?
Q2096	Is your current lack of stable housing: Because of an unhealthy or abusive relationship, either at home or elsewhere?
Q2097	If you've ever used marijuana, did you ever try it at 12 or younger?
Q2574	Are you currently working with any of the Street Outreach teams?

Using the same LASSO methods described in the methodology section, including the same partitions and the outcomes (MH Inpatient, Jail Booking and ER 4+ Visits), we trained three models. Table 20 shows the count of weighted features in the final model, as well as the best Lambda.

Table 20: Best Lambda and Weighted Feature Count (AHA Alternative Assessment)

Model	Best Lambda	Count of weighted features
MH Inpatient	0.01149757	57
Jail Booking	0.01	60
ER 4+ Visits	0.015199111	41

Table 21 is the analog of Table 8, and shows the predictive accuracy of each of the individual alternative models. As expected, given that we are relying on a smaller set of self-disclosed risk factors, relying on VI-SPDAT questions generates lower accuracy, with a reduction in AUC of between three and 11 points.

Table 21: AUC, PPV and TPR of Each Individual Harm Model, Testing Set (Alternative Assessment test)

Model	AUC (95% confidence interval)	PPV for top 10% risk group	TPR for top 10% risk group
MH Inpatient ALT PRM	78.86% [76.09%, 81.45%]	51.53%	28.57%
ER 4+ ALT PRM	71.5% [68.16%, 74.91%]	42.07%	27.17%
Jail ALT PRM	77.02% [74.19%, 79.72%]	61.49%	27.81%

Notes: n= 1,582. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment.

Using the same rules as shown in Figure 2, we used the individual alternative models to develop a single AHA Alternative Assessment score of one to 10. Table 22 is the analog of Table 12 and Table 23 is an analog of Table 13. As expected, the AUC of the AHA Alternative Assessment ranges between 70% and 78%, which is lower than for the AHA where the AUC ranges from 74% and 84%. Both models show highest AUC for MH Inpatient and lowest for Jail. AHA Alternative Assessment is more predictive of these harms than VI-SPDAT scores where AUC ranges from 57% to 59% (see Table 14).

Relative risk of mortality among those scoring 10 vs. those scoring between one and nine is also lower in the AHA Alternative Assessment (2.6 vs 3.6).

Table 22: AUC of AHA Alternative Assessment (for Each Outcome)

Outcome	AUC of AHA Alternative Assessment
MH Inpatient	78.14% [76.55%, 79.73%]
Jail booking	69.98% [68.17%, 71.79%]
ER 4+	73.68% [71.96%, 75.4%]

Notes: n= 5,059. MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment.

Table 23: PPV, TPR and RR of AHA Alternative Assessment (for Each Outcome)

Outcome	TPR - Top 10% - all	PPV - Top 10% - testing	Relative Risk of Mortality (Top 10%)
MH Inpatient	26.84%	47.35%	
Jail booking	19.62%	33.33%	2.64 [1.53,4.55]
ER 4+	24.31%	50.74%	

MH Inpatient: at least one inpatient mental health service funded by Medicaid in the 12 months following the assessment. ER 4+ Visits: More than Four ER visits in the 12 months following the assessment. Jail booking: at least one Allegheny County Jail booking in the 12 months following the assessment.

During the client's interaction with Link staff (in person or over the phone), the Link staff will generate the household's AHA score after they have assessed and confirmed that the household is homeless and meets eligibility requirements. The generated AHA score will also include a "quality indicator" that indicates whether sufficient client history exists in the County's data warehouse to generate a usable AHA score. All people with records in the data warehouse are assigned a unique client identification number called a master client index (MCI) number. In cases where a client does not already have an MCI number prior to their call with the Link, an MCI number will be created during their interaction with the Link staff. The Link staff collect sufficient identifying information during their interaction with the client (prior to calculating the AHA score) to determine if the client already has an MCI number, and the AHA score is generated for that client's MCI number.

For single households, a client will have a quality indicator of 0 or 1. A quality indicator of 0 indicates that the client's MCI number was created less than 90 days before their interaction with the Link. A quality indicator of 1 indicates that the client's MCI number has existed for at least 90 days. In cases where the quality indicator is 0 (expected to be less than 10% of cases), the Link staff will utilize the AHA alternative assessment. In cases where the quality indicator is 1, the generated AHA score will be used.

For households with children, there can be multiple adults (age 18 or older) in the household. A household will also receive a quality indicator based on the average of all adult quality indicators in the household. For example, a household with two adults where one adult has had an MCI number for greater than 90 days (quality indicator of 1) and an adult who has had an MCI number for less than 90 days (quality indicator of 0) would have a household quality indicator of 0.5. In these cases where the household quality indicator is less than one, Link staff will proceed to assess the household using the self-report alternative assessment tool. The higher of the two scores generated, either the AHA score or Alternative Assessment score, will be used as the household's score for prioritization.

Conclusion

When the number of homeless people in need of longer-term housing programs (PSH, RRH/Bridge/Transitional Housing) exceeds the number of beds that are available, all prioritization systems will result in some people remaining unhoused. This essential fact cannot be "fixed" by a prioritization system. It requires more investment in services.

The AHA tool replaces the VI-SPDAT, a prioritization system without local validation. In Allegheny County, the score generated by the VI-SPDAT was uncorrelated to any of the observed harms from which homelessness services are designed to protect. It is important to state here that the current version of the AHA tool is the first version and will be refined over time.

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Appendix A: Predicting future homelessness services

As discussed in the main report, objective measures of future homelessness are not available as a target outcome – since there is no ground truth survey of whether people are rough sleeping or homeless. We therefore experimented with a range of suitable proxies (see Table 24). Additional models were built for these proxies of chronic homelessness as observed in the administrative data, in which we tried to reflect as close as possible the spirit of the HUD definition of homelessness (the individual should have resided in a shelter or institutional setting for more than 12 months over a 36-month period).

We do not have a three-year follow-up period in our data, so Proxy 1 requires that the person has shelter or street outreach contact in four separate months of the 12 months following the assessment (i.e., one-third of the time). The prevalence of this event is10%. Proxy 2 imposes a lower threshold, requiring only two separate interactions (at least one of which should be with street outreach or shelter) in the 12 months following the assessment (but after the initial two months following the assessment). The latter condition ensures that we are focusing on a long-term event. Many people being assessed are currently living in shelter and therefore might meet criteria associated with more proximate shelter stays. Proxy 3 broadens the services that can be considered to include *any* service.

Using the LASSO regression (and the methodology described in LASSO Regularized Logistic Regression), we built three models. The best Lambda and weighted features for each of the models is shown in Table 25.

Table 26 shows the accuracy and relative mortality rates. While the accuracy is not good (AUCs ranging from 66% to 72%), what is particularly undesirable about these models are that those identified as at highest risk have lower relative risk of mortality (i.e., RR of mortality is lower than one as reported in Table 26). Part of the reason for this is clearly that there is survivor bias (to meet the requirement of multiple shelter stays, the person must survive to the end of 12 months). The other PRM models (Jail, MH inpatient. ER 4+) also have this survivor bias, but individuals who score a 10 and are identified as at highest risk are nonetheless at higher relative risk of mortality. This suggests that people who are seen in the administrative data as "long term homeless" are unlikely to be those with highest risk of ground-truth homelessness. For this reason, we decided not to pursue a PRM model that predicted homelessness.

Table 24: Outcomes Used for Future Homelessness Models

Model	Description of Target Outcome	Prevalence
Proxy 1	Had at least one shelter or street outreach homelessness service contact in 4 / 12 unique months in the 12 months following assessment.	10.47%
Proxy 2	Interaction with either of the two services (street outreach or shelter) in the 12 months following the assessment (after current episode-60 days).	20.99%
Proxy 3	Interaction with any of the four services (street outreach, shelter, Bridge/Transitional/RRH or PSH) in the 12 months following the assessment (after current episode-60 days).	32.94%

Table 25: Best Lambda and Weighted Feature Count (Chronic Homelessness PRMs)

Model	Best Lambda	Count of weighted features among 964 features
Proxy 1	0.03053856	26
Proxy 2	0.007564633	120
Proxy 3	0.006579332	154

Table 26: AUC, PPV, TPR and Relative Risk of mortality of Future Homelessness Models, Testing Data

Model	AUC-test	PPV-top 10%-test	TPR-top 10%-test	Relative Mortality of top 10%
Proxy 1	72.07% [67.92%, 76.22%]	26.32%	28.85%	0.96 [0.47,1.98]
Proxy 2	66.96% [63.59%, 70.33%]	41.18%	22.08%	0.58 [0.23, 1.42]
Proxy 3	66.46% [63.56%, 69.36%]	62.50%	19.66%	0.58 [0.23, 1.42]

Notes: n= 1,726. Proxy 1 is having at least one shelter or street outreach homelessness service contact in 4 / 12 unique months in the 12 months following assessment. Proxy 2 is having any interaction with any of the two services, street outreach or shelter in the 12 months following the assessment (after current episode-60 days). Proxy 3 is having any interaction with any of the four services: street outreach, shelter, Bridge/Transitional/RRH, or PSH in the 12 months following the assessment (after current episode-60 days).

Appendix B: Features used for the AHA Model

Variable Name	Variable Description	MH Inpatient	Jail Booking	ER 4+ Visits
PRI_BH_ASSMNT_EVER_COUNT	count of prior behavioral health assessments for the focus client		+	
PRI_BH_IP_DETOX_COUNT_3	total number of days the focus client received an inpatient detox service in the last 1095 days	+		
PRI_BH_IP_REHAB_COUNT_3	total number of days the focus client received an inpatient rehab service in the last 1095 days		+	
PRI_BH_IP_REHAB_COUNT_3_OA	maximum number of days (of all adults in the household) the client received an inpatient rehab service in the last 1095 days	+		
PRI_BH_IP_REHAB_DUMMY_NOW	dummy = 1 if focus client received an inpatient rehab service in the last 3 months or at the time of assessment	+		
PRI_BH_IP_REHAB_EVER_COUNT_OA	maximum number of days (of all adults in the household) the client received an	+		+

	inpatient rehab service in the past			
PRI_BH_LATEST_DAYS_OA	Dummy if any adult in the household had an active behavior health incident	+	+	
PRI_BH_MH_CRISIS_COUNT_1	total number of days the focus client received mental health crisis services in the last 365 days		+	
PRI_BH_MH_CRISIS_DUMMY_NOW	dummy = 1 if focus client received a mental health crisis service in the last 3 months or at time of assessment	+	+	+
PRI_BH_MH_CRISIS_DUMMY_NOW_OA	number of adults in the household who received a mental health crisis service in the last 3 months or at time of assessment (count)	+		
PRI_BH_MH_CRISIS_EVER_COUNT	count of days focus client has received a mental health crisis service in the past	+		
PRI_BH_MH_EMRGNCY_COUNT_3_OA	maximum number of days (of all adults in the household) the client received mental health emergency			+

	services in the last 1095 days			
PRI_BH_MH_EMRGNCY_DUMMY_NOW	dummy = 1 if focus client received a mental health emergency service in the last 3 months or at time of assessment			+
PRI_BH_MH_EMRGNCY_DUMMY_NOW_OA	number of adults in the household that received a mental health emergency service in the last 3 months or at time of assessment (count)	+		
PRI_BH_MH_INPTNT_COUNT_1_OA	maximum number of days (of all adults in the household) the client received mental health inpatient services in the last 365 days	+		
PRI_BH_MH_INPTNT_DUMMY_NOW	dummy = 1 if focus client received a mental health inpatient service in the last 3 months or at time of assessment	+	+	
PRI_BH_MH_INPTNT_DUMMY_NOW_OA	number of adults in the household that received mental health inpatient services in the last 3 months or at time of			+

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	assessment(count)			
PRI_BH_MH_INPTNT_EVER_COUNT	count of days focus client ever received mental health inpatient services	+		+
PRI_BH_OP_DA_COUNT_1	total number of days the focus client received outpatient substance use services in the last 365 days			+
PRI_BH_OP_DA_DUMMY_NOW	dummy = 1 if focus client received outpatient substance use services in the last 3 months or at time of assessment	+		+
PRI_BH_VIC_DX_F25_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Schizoaffective disorder		+	
PRI_BH_VIC_DX_F28_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Oth psych disorder not due to a sub or known physiol cond			+
PRI_BH_VIC_DX_F28_DUMMY_EVER_OA	number of adults in the household with prior diagnosis of Oth psych disorder not due to a sub or known physiol cond			+
PRI_BH_VIC_DX_F31_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Bipolar disorder	+		

PRI_BH_VIC_DX_F32_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Major depressive disorder, single episode		+	
PRI_BH_VIC_DX_F32_DUMMY_EVER_OA	number of adults in the household with a prior diagnosis of Major depressive disorder, single episode	+		
PRI_BH_VIC_DX_F39_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Unspecified mood [affective] disorder			+
PRI_BH_VIC_DX_F39_DUMMY_EVER_OA	number of adults in the household who had a prior diagnosis of Unspecified mood [affective] disorder			+
PRI_BH_VIC_DX_F41_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Other anxiety disorders	+		
PRI_BH_VIC_DX_F50_DUMMY_EVER	Dummy if focus client had a prior diagnosis of Eating disorders	+		
PRI_BH_VIC_DX_F50_DUMMY_EVER_OA	number of adults in the household who had a prior diagnosis of Eating disorders	+		
PRI_BH_VIC_DX_F84_DUMMY_EVER_OC	number of children in the household who had a prior diagnosis of Pervasive	+		

	developmental disorders			
PRI_HL_ACJ_COUNT_1	count of months the focus client was incarcerated in the Allegheny County Jail in the last year		+	+
PRI_HL_ACJ_COUNT_1_OA	Maximum number of months (of all adults in the household) the client was incarcerated in the Allegheny County Jail in the last year			+
PRI_HL_ACJ_COUNT_2	count of months the focus client was incarcerated in the Allegheny County Jail in the last 2 years		+	
PRI_HL_ACJ_COUNT_2_OA	maximum number of months (of all adults in the household) the client was incarcerated in the Allegheny County Jail in the last 2 years		+	
PRI_HL_ACJ_COUNT_3_OA	maximum number of months (of all adults in the household) the client was incarcerated in the Allegheny County Jail in the last 3 years		+	
PRI_HL_ACJ_DUMMY_EVER	count of months the focus client was incarcerated		+	

	in the Allegheny County Jail in the past			
PRI_HL_CRT_ALL_COUNT_1	count of months the focus client was active in the Courts in the last year		+	
PRI_HL_CRT_ALL_DUMMY_EVER	count of months the focus client was court-active in the past		+	
PRI_HL_CRT_ALL_DUMMY_NOW	dummy if the focus client was court-active at the time of the assessment	+	+	
PRI_HL_CRT_CM_PLS_CRM_ACV_DUMMY _NOW	dummy if focus client was active in Common Pleas – ACV court at the time of the assessment		+	
PRI_HL_CRT_CM_PLS_CRM_DUMMY_NO W	dummy if focus client was active in criminal court at the time of assessment		+	
PRI_HL_CRT_FAM_DUMMY_EVER_OA	maximum count of months (of all adults in the household) the client was active in family court in the past	+		
PRI_HL_CRT_MAJ_DIST_CRM_COUNT_1	count of months the focus client was active with the Magisterial District Court in the last year		+	+
PRI_HL_CRT_MAJ_DIST_CRM_COUNT_2	count of months the focus client was active with the Magisterial		+	

	District Court in the last 2 years				
PRI_HL_CRT_MAJ_DIST_CRM_DUMMY_NOW	dummy if the focus client was active with the Magisterial District Court at the time of assessment		+		
PRI_HL_CRT_MAJ_DIST_CRM_DUMMY_NOW_OA	number of adults in the household that were active with the Magisterial District Court at the time of assessment		+		
PRI_HL_CRT_MAJ_DIST_NTR_DUMMY_NOW	dummy if focus client was active with the Magisterial District Court – NTR at the time of assessment	+	+		
PRI_HL_CRT_MAJ_DIST_TRF_DUMMY_EVER	count of months the focus client was active with the Magisterial District Court – TRF in the past	+			
PRI_HL_CRT_PROB_DUMMY_EVER	count of months the focus client was under probation supervision in the past	+			
PRI_HL_CYF_REF_ACCEPT_FOR_SERVICE_EVER_COUNT_OC	maximum count of prior child welfare referrals (of all children in the household) that were screened-in/ accepted for service	+			
PRI_HL_CYF_REF_CHIL_SCI_1_COUNT	count of child welfare referrals	+			

	for the focus client in the last 1 year that were screened in			
PRI_HL_CYF_REF_CHIL_SCI_3_COUNT_OA	maximum count of child welfare referrals (of all adults in the household) for the focus client in the last 3 years that were screened in	+		
PRI_HL_CYF_REF_CHIL_SCO_1_COUNT_OC	maximum count of child welfare referrals (of all children in the household) for the child in the last 1 year that were screened out	+		
PRI_HL_CYF_REF_CHIL_SCO_3_COUNT_OC	maximum count of child welfare referrals (of all children in the household) for the child in the last 3 years that were screened out	+		
PRI_HL_CYF_REF_CHIL_SCO_EVER_COUNT	count of all prior child welfare referrals for the focus client that were screened out	+		
PRI_HL_CYF_REF_OTHE_SCI_1_COUNT	count of child welfare referrals for the focus client in the last 1 year that were screened in	+		
PRI_HL_CYF_REF_OTHE_SCI_1_COUNT_OA	maximum count of child welfare referrals (of all adults in the	+		

	household) for the client in the last 1 year that were screened in			
PRI_HL_CYF_REF_OTHE_SCI_2_COUNT	count of child welfare referrals for the focus client in the last 2 years that were screened in	+		+
PRI_HL_CYF_REF_OTHE_SCI_2_COUNT_OA	maximum count of child welfare referrals (of all adults in the household) for the client in the last 2 years that were screened in	+		
PRI_HL_CYF_REF_OTHE_SCO_3_COUNT_OA	maximum count of child welfare referrals (of all adults in the household) for the client in the last 3 years that were screened out	+		
PRI_HL_CYF_REF_PARE_SCA_1_COUNT	count of child welfare referrals for the focus client in the last 1 year with a role of parent that were received while the family had an open child welfare case	+		
PRI_HL_CYF_REF_PARE_SCI_3_COUNT	count of child welfare referrals for member in the last 3 years with a role of parent that were screened in	+		
PRI_HL_CYF_REF_PERP_SCA_2_COUNT	count of child welfare referrals	+		

	for the focus client in the last 2 years with a role of perpetrator that were received while the family had an open child welfare case			
PRI_HL_CYF_REF_PERP_SCA_3_COUNT	count of child welfare referrals for the focus client in the last 3 years with a role of perpetrator that were received while the family had an open child welfare case	+		
PRI_HL_CYF_REF_VICT_SCA_2_COUNT_OA	maximum count of child welfare referrals (of all adults in the household) for the client in the last 2 years with a role of victim that were received while the family had an open child welfare case	+		
PRI_HL_CYF_REF_VICT_SCA_3_COUNT_OA	maximum count of child welfare referrals (of all adults in the household) for the client in the last 3 years with a role of victim that were received while the family had an	+		

	open child welfare case			
PRI_HL_CYF_REF_VICT_SCA_EVER_COUNT_OA	maximum count of all prior child welfare referrals (of all adults in the household) for the client with a role of perpetrator while the family had an open child welfare case	+		
PRI_HL_CYF_REF_VICT_SCO_EVER_COUNT	count of all prior child welfare referrals for the focus client with a role of victim that were screened out	+		
PRI_HL_HA_RES_ACHA_DUMMY_EVER	count of months the focus client was ever in assisted housing from Allegheny County Housing Authority (ACHA)	+		
PRI_HL_HA_RES_ACHA_DUMMY_EVER_OA	maximum count of months (of all adults in the household) the client ever in assisted housing from Allegheny maximum county Housing Authority (ACHA)	+		
PRI_HL_HA_RES_HACP_DUMMY_EVER_OC	maximum count of months (of all children in the household) the child was ever in assisted housing from Housing Authority of the City of Pittsburgh (HACP)	+		

PRI_HL_HA_S8_HACP_COUNT_3_OA	maximum count of months (of all adults in the household) the client was in Section 8 housing with the Housing Authority of the City of Pittsburgh (HACP) in the last 3 years	+		
PRI_HL_HA_S8_HACP_DUMMY_EVER	count of months the focus client was ever in Section 8 housing with the Housing Authority of the City of Pittsburgh (HACP)			+
PRI_HL_HH_PREVENTION_DAYS_3	count of days the focus client received homeless prevention services in the last 3 years	+		
PRI_HL_HH_PREVENTION_EPISODES_1	count of episodes the focus client had in a homeless prevention program in the last year	+		
PRI_HL_HH_PREVENTION_EPISODES_2	count of episodes the focus client had in a homeless prevention program in the last 2 years	+		
PRI_HL_HH_PSH_DAYS_1	count of days the focus client was in Permanent Supportive			+

	Housing in the last year			
PRI_HL_HH_PSH_DAYS_1_OA	maximum number of days (of all adults in the household) the client was in Permanent Supportive Housing in the last year	+		
PRI_HL_HH_PSH_DAYS_2	count of days the focus client was in Permanent Supportive Housing in the last two years			+
PRI_HL_HH_PSH_DAYS_DUMMY_EVER_OC	maximum number of days (of all children in the household) the child was in Permanent Supportive Housing	+		
PRI_HL_HH_PSH_EPISODES_1_OA	maximum number of episodes (of all adults in the household) the client was in Permanent Supportive Housing in the last year	+		
PRI_HL_HH_PSH_EPISODES_2	count of episodes in Permanent Supportive Housing the focus client had in the last 2 years			+
PRI_HL_HH_PSH_EPISODES_DUMMY_EVER_OC	count of children in the household who have lived in Permanent	+		

Variable	Description			
	Supportive Housing			
PRI_HL_HH_SERVICE_EPISODES_DUMMY_EVER_OC	Count of children in the household who have received homeless and housing support services	+		
PRI_HL_HH_SHELTER_DAYS_1	count of days the focus client was in a homeless shelter in the last year	+		
PRI_HL_HH_SHELTER_DAYS_3_OA	maximum number of days (of all adults in the household) the client was in a homeless shelter in the last 3 years		+	
PRI_HL_HH_SHELTER_DUMMY_NOW	dummy if the focus client was in a homeless shelter at the time of the assessment	+		
PRI_HL_HH_STREET_OUTREACH_DUMMY_NOW	dummy if the member was in Street Outreach at the time of the assessment		+	
PRI_HL_HH_TRANSITIONAL_DAYS_DUMMY_EVER_OA	maximum number of days (of all adults in the household) the client was ever in Bridge/Transitional/Rapid Re-Housing		+	
PRI_HL_HH_TRANSITIONAL_DUMMY_NOW_OA	total number of adults in the household in Bridge/Transitional/Rapid Re-	+		

	housing at the time of the assessment			
PRI_HL_POV_DUMMY_0	dummy = 1 if poverty rate code = 0; 0 otherwise (based on zip code)	+		
PRI_HL_POV_DUMMY_OVER_30	dummy = 1 if poverty rate is greater than 30; 0 otherwise (based on zip code)		+	
PRI_MCI_UNIQ_AGE	Focus client's age at assessment		+	
PRI_MCI_UNIQ_AGE_17BELOW	dummy = 1 if the focus client was less than 17 years old at time of assessment; 0 otherwise	+	+	+
PRI_MCI_UNIQ_AGE_20_24_DUMMY_OA	Count of adults in the household between the ages of 20-24	+		
PRI_MCI_UNIQ_AGE_25_29	dummy=1 if the focus client was between the ages of 25 and 29 at the time of assessment		+	
PRI_MCI_UNIQ_AGE_25_29_DUMMY_OA	Count of adults in the household between the ages of 25-29	+		
PRI_MCI_UNIQ_AGE_30_34	dummy=1 if the focus client was between the ages of 30 and 34 at the time of assessment	+		
PRI_MCI_UNIQ_AGE_50_59	I dummy=1 if the focus client was between the	+		

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	ages of 50 and 59 at the time of assessment			
PRI_MCI_UNIQ_AGE_60_69_DUMMY_OA	Count of adults in the household between the ages of 60-69	+		
PRI_MCI_UNIQ_AGE_ADULT_DUMMY_OA	Count of clients in the household that are >=18 years old at the time of assessment	+		
PRI_MCI_UNIQ_AGE_CHILD_DUMMY_OC	Count of clients in the household that are <18 years old at the time of assessment	+	+	
PRI_MCI_UNIQ_AGE_SC2_DUMMY_OC	Count of clients in the household that are between the ages of 3 and 6 at the time of assessment	+		
PRI_MCI_UNIQ_AGE_TEEN_DUMMY_OC	Count of clients in the household that are between the ages of 13 and 18 at the time of assessment	+		
PRI_MCI_UNIQ_FEMALE_DUMMY_OA	Count of adults in the household that are female	+	+	
PRI_PH_DUMMY_NOW	dummy = 1 if focus client received a Physical health service in the last 3 months or at time of assessment	+		+
PRI_PH_ED_COUNT_1	total number of times the focus client visited the	+		+

	Emergency Room in the last 365 days			
PRI_PH_ED_DUMMY_NOW	dummy = 1 if the focus client had an emergency room visit in the last three months at the time of assessment	+	+	+
PRI_PH_EVER_COUNT	count of physical health services focus client received in the past			+
PRI_REF_POV_DUMMY_UNDER_10_OC	Count of children in a zip code with poverty rate less than 10		+	
PRI_REF_POV_DUMMY_UNDER_30_OA	Count of adults in a zip code with poverty rate greater than 20 and less than 30	+		
PRI_REF_POV_DUMMY_UNDER_30_OC	Count of children in a zip code with poverty rate greater than 20 and less than 30	+		
PRI_REF_POV_DUMMY_UNMATCHED_OC	Count of children with poverty rate unknown, zip code not available	+		
PRI_REF_POV_POVERTY_RATE_OC	Poverty Rate obtained using externally provided Zipcode_poverty rate file, this file comes from the 2008-2012 5-year American Community Survey (ACS) ZIP code statistics	+		

Appendix C: Questions from VI-SPDAT used for the AHA Alternative Assessment Model

Variable Name	Variable Description	Question Description	MH Inpatient	Jail Booking	ER 4+ Visits
PRI_MCI_UNIQ_AGE_18_19	dummy if the individual is between the ages of 18 and 19 at time of retro	Date of birth		+	
PRI_MCI_UNIQ_AGE_20_24	dummy if the individual is between the ages of 20 and 24 at time of retro	Date of birth	+		
PRI_MCI_UNIQ_AGE_25_29	dummy the individual is between the ages of 25 and 29 at time of retro	Date of birth	+		
PRI_MCI_UNIQ_AGE_30_34	dummy if the individual is between the ages of 30 and 34 at time of retro	Date of birth	+		
PRI_MCI_UNIQ_AGE_50_59	dummy if the individual is between the ages of 50 and 59 at time of retro	Date of birth		+	
PRI_MCI_UNIQ_AGE_60_69	dummy if the individual is between the ages of 60 and 69 at time of retro	Date of birth	+		
PRI_MCI_UNIQ_AGE_AT_RETRO_DATE	Numeric age at the Retro Date	Date of birth		+	
PRI_MCI_UNIQ_AGE_LESS_THAN_18	dummy if the individual is less than 18 years old at time of retro	Date of birth	+		+
PRI_MCI_UNIQ_FEMALE_DUMMY	Dummy if female	Gender	+	+	+
PRI_Q1885_Q1956_Dummy_More_than_a_year	Dummy if the answer for Q1885 is "More than a year"	How long has it been since you have lived in permanent stable housing? Or how long has it been since you and your family have lived in permanent stable housing?		+	+
PRI_Q1889_Q1952_Dummy_No	Dummy if the answer for Q1889 is "no"	Have you served in the military? /Has anyone in your household served in the military?	+	+	+
PRI_Q1889_Q1952_Dummy_Yes	Dummy if the answer for Q1889 is "yes"	Have you served in the military? /Has anyone in your household served in the military?	+		
PRI_Q1891_Q1953_Dummy_No	Dummy if the answer for Q1891 is "no"	Are you living with a disability? /Is anyone in the household living with a disability?	+	+	
PRI_Q1894_Q1960_Dummy_0	Dummy if the answer for Q1894 is 0	In the past six months, how many times have you or	+		+

		anyone in your family received health care at an emergency department/room?			
PRI_Q1894_Q1960 _Dummy_1	Dummy if the answer for Q1894 is 1	In the past six months, how many times have you or anyone in your family received health care at an emergency department/room?	+		+
PRI_Q1894_Q1960 _Dummy_3	Dummy if the answer for Q1894 is 3	In the past six months, how many times have you or anyone in your family received health care at an emergency department/room?	+		
PRI_Q1894_Q1960 _Dummy_4	Dummy if the answer for Q1894 is 4	In the past six months, how many times have you or anyone in your family received health care at an emergency department/room?			+
PRI_Q1894_Q1960 _Dummy_5	Dummy if the answer for Q1894 is 5	In the past six months, how many times have you or anyone in your family received health care at an emergency department/room?	+	+	
PRI_Q1894_Q1960 _Dummy_6PLUS	Dummy if the answer for Q1894 is no less than 6	In the past six months, how many times have you or anyone in your family received health care at an emergency department/room?	+	+	+
PRI_Q1895_Q1961 _Dummy_0	Dummy if the answer for Q1895 is 0	In the past six months, how many times have you or anyone in your family taken an ambulance to the hospital?	+	+	+
PRI_Q1895_Q1961 _Dummy_1	Dummy if the answer for Q1895 is 1	In the past six months, how many times have you or anyone in your family taken an ambulance to the hospital?			+
PRI_Q1895_Q1961 _Dummy_3	Dummy if the answer for Q1895 is 3	In the past six months, how many times have you or anyone in your family taken		+	

		an ambulance to the hospital?			
PRI_Q1895_Q1961 _Dummy_5	Dummy if the answer for Q1895 is 5	In the past six months, how many times have you or anyone in your family taken an ambulance to the hospital?			+
PRI_Q1895_Q1961 _Dummy_6PLUS	Dummy if the answer for Q1895 is no less than 6	In the past six months, how many times have you or anyone in your family taken an ambulance to the hospital?	+	+	
PRI_Q1895_Q1961 _Dummy_Refused	Dummy if the answer for Q1895 is "Refused"	In the past six months, how many times have you or anyone in your family taken an ambulance to the hospital?		+	
PRI_Q1896_Q1962 _Dummy_0	Dummy if the answer for Q1896 is 0	In the past six months, how many times have you or anyone in your family been hospitalized as an inpatient?	+		+
PRI_Q1896_Q1962 _Dummy_4	Dummy if the answer for Q1896 is 4	In the past six months, how many times have you or anyone in your family been hospitalized as an inpatient?	+		
PRI_Q1896_Q1962 _Dummy_5PLUS	Dummy if the answer for Q1896 is no less than 5	In the past six months, how many times have you or anyone in your family been hospitalized as an inpatient?	+	+	
PRI_Q1897_Q1963 _Dummy_0	Dummy if the answer for Q1897 is 0	In the past six months, how many times have you or anyone in your family used a crisis service, including sexual assault crisis, mental health crisis, family. Or, intimate violence, distress centers and suicide prevention hotlines?	+		+
PRI_Q1897_Q1963 _Dummy_3	Dummy if the answer for Q1897 is 3	In the past six months, how many times have you or anyone in your family used a crisis service, including sexual assault crisis, mental health crisis, family. Or, intimate violence, distress		+	

		centers and suicide prevention hotlines?			
PRI_Q1897_Q1963 _Dummy_4	Dummy if the answer for Q1897 is 4	In the past six months, how many times have you or anyone in your family used a crisis service, including sexual assault crisis, mental health crisis, family. Or, intimate violence, distress centers and suicide prevention hotlines?	+		
PRI_Q1897_Q1963 _Dummy_5	Dummy if the answer for Q1897 is 5	In the past six months, how many times have you or anyone in your family used a crisis service, including sexual assault crisis, mental health crisis, family. Or, intimate violence, distress centers and suicide prevention hotlines?	+	+	
PRI_Q1897_Q1963 _Dummy_6PLUS	Dummy if the answer for Q1897 is no less than 6	In the past six months, how many times have you or anyone in your family used a crisis service, including sexual assault crisis, mental health crisis, family. Or, intimate violence, distress centers and suicide prevention hotlines?	+		
PRI_Q1898_Q1964 _Dummy_0	Dummy if the answer for Q1898 is 0	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police told you that you must move along?		+	
PRI_Q1898_Q1964 _Dummy_3	Dummy if the answer for Q1898 is 3	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police			+

		told you that you must move along?			
PRI_Q1898_Q1964 _Dummy_4	Dummy if the answer for Q1898 is 4	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police told you that you must move along?	+		
PRI_Q1898_Q1964 _Dummy_6PLUS	Dummy if the answer for Q1898 is no less than 6	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police told you that you must move along?		+	
PRI_Q1898_Q1964 _Dummy_Refused	Dummy if the answer for Q1898 is "Refused"	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police told you that you must move along?	+	+	
PRI_Q1898_Q1964 _MISS_Dummy	Dummy if the answer for Q1898 is missing	In the past six months, how many times have you or anyone in your family talked to police because you witnessed a crime, were the victim of a crime, or the alleged perpetrator of a crime or because the police told you that you must move along?		+	
PRI_Q1899_Dummy _0	Dummy if the answer for Q1899 is 0	In the past six months, how many times have you or anyone in your family stayed one night in a holding cell, jail or prison, whether that was a short-term stay like a		+	+

		drunk tank, a longer stay for a more serious offence, or anything in between?			
PRI_Q1899_Dummy_2	Dummy if the answer for Q1899 is 2	In the past six months, how many times have you or anyone in your family stayed one night in a holding cell, jail or prison, whether that was a short-term stay like a drunk tank, a longer stay for a more serious offence, or anything in between?	+	+	
PRI_Q1899_Dummy_3PLUS	Dummy if the answer for Q1899 is no less than 3	In the past six months, how many times have you or anyone in your family stayed one night in a holding cell, jail or prison, whether that was a short-term stay like a drunk tank, a longer stay for a more serious offence, or anything in between?		+	+
PRI_Q1899_Dummy_Refused	Dummy if the answer for Q1899 is "Refused"	In the past six months, how many times have you or anyone in your family stayed one night in a holding cell, jail or prison, whether that was a short-term stay like a drunk tank, a longer stay for a more serious offence, or anything in between?	+	+	+
PRI_Q1903_Q1969_Dummy_No	Dummy if the answer for Q1903 is "no"	Megan's Law Registrant		+	+
PRI_Q1903_Q1969_Dummy_Yes	Dummy if the answer for Q1903 is "yes"	Megan's Law Registrant	+		
PRI_Q1904_Q1970_Dummy_Yes	Dummy if the answer for Q1904 is "yes"	Arson Conviction	+	+	
PRI_Q1905_Q1971_Dummy_No	Dummy if the answer for Q1905 is "no"	Do you have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that make it more difficult to rent a place to live? Does anyone in your family have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that	+		

		make it more difficult to rent a place to live?			
PRI_Q1905_Q1971 _Dummy_Yes	Dummy if the answer for Q1905 is "yes"	Do you have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that make it more difficult to rent a place to live? Does anyone in your family have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that make it more difficult to rent a place to live?		+	
PRI_Q1905_Q1971 _MISS_Dummy	Dummy if the answer for Q1905 is missing	Do you have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that make it more difficult to rent a place to live? Does anyone in your family have any legal stuff going on right now that may result in you being locked up, having to pay fines, or that make it more difficult to rent a place to live?		+	
PRI_Q1907_Q1973 _Dummy_Refused	Dummy if the answer for Q1907 is "Refused"	Do you ever do things that may be considered to be risky like exchange sex for money, run drugs for someone, have unprotected sex with someone you don't know, share a needle, or anything like that? Do you or anyone in your family ever do things that may be considered to be risky like exchange sex for money, run drugs for someone, have unprotected sex with someone you don't know, share a needle, or anything like that?		+	
PRI_Q1907_Q1973 _Dummy_Yes	Dummy if the answer for Q1907 is "yes"	Do you ever do things that may be considered to be	+	+	+

		risky like exchange sex for money, run drugs for someone, have unprotected sex with someone you don't know, share a needle, or anything like that? Do you or anyone in your family ever do things that may be considered to be risky like exchange sex for money, run drugs for someone, have unprotected sex with someone you don't know, share a needle, or anything like that?			
PRI_Q1908_Q1974 _Dummy_No	Dummy if the answer for Q1908 is "no"	Is there any person, past landlord, business, bookie, dealer, or government group like the IRS that thinks you owe them money? Is there any person, past landlord, business, bookie, dealer, or government group like the IRS that thinks you or anyone in your family owe them money?			+
PRI_Q1908_Q1974 _Dummy_Refused	Dummy if the answer for Q1908 is "Refused"	Is there any person, past landlord, business, bookie, dealer, or government group like the IRS that thinks you owe them money? Is there any person, past landlord, business, bookie, dealer, or government group like the IRS that thinks you or anyone in your family owe them money?		+	
PRI_Q1908_Q1974 _Dummy_Yes	Dummy if the answer for Q1908 is "yes"	Is there any person, past landlord, business, bookie, dealer, or government group like the IRS that thinks you owe them money? Is there any person, past landlord, business, bookie,	+	+	

Variable	Description	Question			
		dealer, or government group like the IRS that thinks you or anyone in your family owe them money?			
PRI_Q1909_Q1975_MISS_Dummy	Dummy if the answer for Q1909 is missing	Do you get any money from the government, a pension, an inheritance, working under the table, a regular job, or anything like that? Do you or anyone in your family get any money from the government, a pension, an inheritance, working under the table, a regular job, or anything like that?			+
PRI_Q1910_Q1976_income	Income of the household	What is the total household income?		+	
PRI_Q1910_Q1976_income_between1000and2000_Dummy	Dummy if the answer for Q1910 is greater than 1000 and no more than 2000	What is the total household income?	+	+	+
PRI_Q1910_Q1976_income_between700and1000_Dummy	Dummy if the answer for Q1910 is greater than 700 and no more than 1000	What is the total household income?		+	+
PRI_Q1911_percentAMI_between3and6_Dummy	Dummy if the answer for Q1911 is greater than 3 and no more than 6	% of AMI			+
PRI_Q1911_percentAMI_between6and9_Dummy	Dummy if the answer for Q1911 is greater than 6 and no more than 9	% of AMI			+
PRI_Q1912_percentFPL_between11and17_Dummy	Dummy if the answer for Q1912 is greater than 11 and no more than 17	% of FPL		+	
PRI_Q1912_percentFPL_between17and23_Dummy	Dummy if the answer for Q1912 is greater than 17 and no more than 23	% of FPL	+		
PRI_Q1912_percentFPL_between23and70_Dummy	Dummy if the answer for Q1912 is greater than 23 and no more than 70	% of FPL		+	
PRI_Q1912_percentFPL_between70and100_Dummy	Dummy if the answer for Q1912 is greater than 70 and no more than 100	% of FPL	+		
PRI_Q1912_percentFPL_greaterThan100_Dummy	Dummy if the answer for Q1912 is greater than 100	% of FPL	+		+
PRI_Q1916_Q1980_Dummy_Yes	Dummy if the answer for Q1916 is "yes"	Are you currently experiencing domestic	+		

		violence? Is your family currently experiencing domestic violence?			
PRI_Q1919_Q1983 _Dummy_Yes	Dummy if the answer for Q1919 is "yes"	Do you have any chronic health issues with your liver, kidneys, stomach, lungs or heart? Do you or anyone in your family have any chronic health issues with your liver, kidneys, stomach, lungs or heart? Do you or anyone in your family have any chronic health issues with your liver, kidneys, stomach, lungs or heart?			+
PRI_Q1924_Dummy _No	Dummy if the answer for Q1924 is "no"	Requires a wheelchair accessible unit exclusively?		+	
PRI_Q1924_Dummy _Yes	Dummy if the answer for Q1924 is "yes"	Requires a wheelchair accessible unit exclusively?			+
PRI_Q1925_Q1989 _Dummy_Refused	Dummy if the answer for Q1925 is "Refused"	When you are sick or not feeling well, do you avoid getting help? When someone in your family is sick or not feeling well, does your family avoid getting medical help?	+		
PRI_Q1925_Q1989 _MISS_Dummy	Dummy if the answer for Q1925 is missing	When you are sick or not feeling well, do you avoid getting help? When someone in your family is sick or not feeling well, does your family avoid getting medical help?	+		
PRI_Q1927_Dummy _Between_5_and_7	Dummy if the answer for Q1927 is "Between 5 and 7"	How far along in your pregnancy are you?			+
PRI_Q1927_Dummy _More_than_7	Dummy if the answer for Q1927 is "More than 7"	How far along in your pregnancy are you?		+	
PRI_Q1927_MISS_ Dummy	Dummy if the answer for Q1927 is missing	How far along in your pregnancy are you?	+		
PRI_Q1931_Q1993 _Dummy_No	Dummy if the answer for Q1931 is "no"	Has your drinking or drug use led you to being kicked out of an apartment or program where you were	+	+	

		staying in the past? Has your drinking or drug use by you or anyone in your family led you to being kicked out of an apartment or program where you were staying in the past?			
PRI_Q1931_Q1993 _Dummy_Refused	Dummy if the answer for Q1931 is "Refused"	Has your drinking or drug use led you to being kicked out of an apartment or program where you were staying in the past? Has your drinking or drug use by you or anyone in your family led you to being kicked out of an apartment or program where you were staying in the past?		+	
PRI_Q1931_Q1993 _Dummy_Yes	Dummy if the answer for Q1931 is "yes"	Has your drinking or drug use led you to being kicked out of an apartment or program where you were staying in the past? Has your drinking or drug use by you or anyone in your family led you to being kicked out of an apartment or program where you were staying in the past?	+		
PRI_Q1935_Dummy _No	Dummy if the answer for Q1935 is "no"	A mental health issue or concern?	+		
PRI_Q1935_Dummy _Refused	Dummy if the answer for Q1935 is "Refused"	A mental health issue or concern?		+	
PRI_Q1935_Dummy _Yes	Dummy if the answer for Q1935 is "yes"	A mental health issue or concern?	+		
PRI_Q1937_Dummy _No	Dummy if the answer for Q1937 is "no"	A learning disability, developmental disability, or other impairment?		+	+
PRI_Q1937_Dummy _Refused	Dummy if the answer for Q1937 is "Refused"	A learning disability, developmental disability, or other impairment?	+		
PRI_Q1937_MISS_ Dummy	Dummy if the answer for Q1937 is missing	A learning disability, developmental disability, or other impairment?		+	

PRI_Q1947_Q2053 _MISS_Dummy	Dummy if the answer for Q1947 is missing	How many children under the age of 18 are currently with you?		+	
PRI_Q1947_Q2053 _with_0_Children_D ummy	Dummy if the answer for Q1947 is 0	How many children under the age of 18 are currently with you?			+
PRI_Q1947_Q2053 _with_1_Children_D ummy	Dummy if the answer for Q1947 is 1	How many children under the age of 18 are currently with you?			+
PRI_Q1947_Q2053 _with_2_Children_D ummy	Dummy if the answer for Q1947 is 2	How many children under the age of 18 are currently with you?	+	+	+
PRI_Q1947_Q2053 _with_3_Children_D ummy	Dummy if the answer for Q1947 is 3	How many children under the age of 18 are currently with you?	+		+
PRI_Q1947_Q2053 _with_4+_Children_ Dummy	Dummy if the answer for Q1947 is more than 3	How many children under the age of 18 are currently with you?	+	+	
PRI_Q1948_Q2054 _with_1_Children_D ummy	Dummy if the answer for Q1948 is 1	How many children under the age of 18 are not currently with your family, but you have reason to believe they will be joining you when you get housed?			+
PRI_Q1948_Q2054 _with_2_Children_D ummy	Dummy if the answer for Q1948 is 2	How many children under the age of 18 are not currently with your family, but you have reason to believe they will be joining you when you get housed?		+	
PRI_Q1954_Q1892 _Dummy_No	Dummy if the answer for Q1954 is "no"	Has anyone ever told you that you have a mental health diagnosis such as depression, bipolar, Schizophrenia or anything like that? Has anyone ever told you that you or anyone in your family have a mental health diagnosis such as depression, bipolar, Schizophrenia or anything like that?	+	+	+
PRI_Q1954_Q1892 _Dummy_Yes	Dummy if the answer for Q1954 is "yes"	Has anyone ever told you that you have a mental health diagnosis such as	+		

		depression, bipolar, Schizophrenia or anything like that? Has anyone ever told you that you or anyone in your family have a mental health diagnosis such as depression, bipolar, Schizophrenia or anything like that?			
PRI_Q1954_Q1892_MISS_Dummy	Dummy if the answer for Q1954 is missing	Has anyone ever told you that you have a mental health diagnosis such as depression, bipolar, Schizophrenia or anything like that? Has anyone ever told you that you or anyone in your family have a mental health diagnosis such as depression, bipolar, Schizophrenia or anything like that?	+	+	
PRI_Q1984_Q1920_Dummy_No	Dummy if the answer for Q1920 is "no"	Are you living with HIV/AIDS? /Is anyone in the household living with HIV/AIDS?	+		
PRI_Q2005_Q1890_Dummy_Yes	Dummy if the answer for Q2005 is "yes"	Were you involved in the child welfare system when turning 18? Was anyone in your household involved in the child welfare system when turning 18?		+	+
PRI_Q2006_Dummy_No	Dummy if the answer for Q2006 is "no"	Are there any children that have been removed from the family by a child protection service within the last 180 days?	+	+	+
PRI_Q2006_MISS_Dummy	Dummy if the answer for Q2006 is missing	Are there any children that have been removed from the family by a child protection service within the last 180 days?	+		+
PRI_Q2010_Dummy_No	Dummy if the answer for Q2010 is "no"	IF THERE ARE SCHOOL-AGED CHILDREN: Do your	+		

		children attend school more often than not each week?			
PRI_Q2010_Dummy _Yes	Dummy if the answer for Q2010 is "yes"	IF THERE ARE SCHOOL-AGED CHILDREN: Do your children attend school more often than not each week?		+	+
PRI_Q2070_Q2075 _Dummy_3_or_less	Dummy if the answer for Q2070 is "3 or less"	Of those times you were homeless, how many times have you been street homeless? Of those times you were homeless, how many times have you and your family been street homeless?	+	+	
PRI_Q2071_MISS_ Dummy	Dummy if the answer for Q2071 is missing	If you had to put all those times together, how long would it be?		+	
PRI_Q2072_Dummy _No	Dummy if the answer for Q2072 is "no"	Is the Head of Household living with a disability?			+
PRI_Q2073_Q2074 _Dummy_More_tha n_a_year	Dummy if the answer for Q2073 is "More than a year"	How long have you been street homeless (Street, Shelter, Safe Haven)? How long have you and your family been street homeless (Street, Shelter, Safe Haven)?		+	
PRI_Q2089_Dummy _Refused	Dummy if the answer for Q2089 is "Refused"	Were you ever incarcerated when younger than 18?	+		
PRI_Q2089_Dummy _Yes	Dummy if the answer for Q2089 is "yes"	Were you ever incarcerated when younger than 18?		+	
PRI_Q2092_Dummy _Yes	Dummy if the answer for Q2092 is "yes"	Is your current lack of stable housing: Because of a difference in religious or cultural beliefs from your parents, guardians or caregivers?		+	
PRI_Q2094_Dummy _Yes	Dummy if the answer for Q2094 is "yes"	Is your current lack of stable housing: Because of conflicts around gender identity or sexual orientation?		+	
PRI_Q2095_Dummy _Yes	Dummy if the answer for Q2095 is "yes"	Is your current lack of stable housing: Because of violence at home between family members?		+	